Lymphatic Filariasis Elimination: Platform for Neglected Tropical Diseases Control in Ghana

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PhD Thesis

2012

Dedicated

To

Abena

Akosua, Yaw and Akosua

'Who have endured the long period of waiting

in the hope that all this pays off'

and

To

God

'Who makes all things beautiful in His time'

Abstract

The World Health Assembly resolution (WHA 50.29) called for the elimination of lymphatic filariasis (LF) as a public health problem and set in motion a series of global, regional and country activities aimed at the achievement of this objective, the guiding principle of Ghana's programme to eliminate LF. The main goal of this study is to determine the impact of mass drug administration (MDA) on the prevalence and transmission intensity of LF and investigate the suitability of the community directed approach as a vehicle for developing an integrated treatment strategy and plan targeting other neglected tropical diseases (NTDs) amenable to MDA within the context of the health system. To determine the impact of the Ghana Filariasis Elimination Programme on LF elimination and on other NTDs amenable to MDA and the health system

Ghana has an estimated population of 25 million and is endemic for all the diseases targeted with preventive chemotherapy. The country has been mapped for all these diseases. The Lymphatic Filariasis Elimination Programme, serving as an implementation platform, has made significant impacts on the epidemiology, implementation of LF elimination and implementation of other NTDs and within overall health system service provision. These diseases are LF, onchocerciasis, soil transmitted helminthiasis, schistosomiasis and trachoma.

This evaluation has revealed that NTDs are among the most disabling and stigmatising conditions with long-term sequelae. The awareness of other NTDs amenable to preventive chemotherapy was low compared to LF. Microfilaria prevalence and immuno-parasitologic indicators have shown significant downward trends in all districts including the five start-up districts on the programme. Districts with high prevalence at baseline had difficulty in

achieving end points after six rounds of MDA. One of the five start-up districts demonstrated the possibility this could be achieved after further two years of treatment. The number of years required to break LF transmission requires reviewing. Operational issues including therapeutic and geographic coverage, compliance with MDA, mosquito vector characteristics and drug regimens should be considered.

Morbidity control builds the confidence of communities in the programme with improvements in the physical, social and economic life of beneficiaries. Mobility, self care and ability to undertake activities had improved while pain, discomfort, anxiety and depression associated with hydrocoele had reduced after hydrocoelectomy.

Remapping of onchocerciasis has been undertaken, biannual treatments of onchocerciasis using ivermectin instituted and declining trends have been observed. Schistosomiasis and soil transmitted helminthiasis have been mapped and regular treatment instituted. Trachoma elimination is in sight. Health systems impacts have been demonstrated at the national, regional, district and community levels. International and local partnerships have been strengthened.

Acknowledgements

"Gratitude is not only the greatest of virtues, but the parent of all others."

— Marcus Tullius Cicero

"Let us be grateful to the people who make us happy; they are the charming gardeners who make our souls blossom."

— Marcel Proust

Many people have enabled me complete this work. I am greatly indebted to them all and would like to acknowledge with appreciation the contributions of all who provided various forms of support during the period of this study.

Professor David Molyneux, my primary supervisor provided guidance throughout the study and write-up. He was readily available and made it possible for me to complete this study and write-up despite the personal challenges encountered. He helped to ensure financial support after my enrolment with the Liverpool School of Tropical Medicine through the Lymphatic Filariasis Support Centre (LFSC) now the Centre for Neglected Tropical Diseases (CNTD). This support helped with my fieldwork, visits to Liverpool and associated programme implementation costs. Professor Molyneux also found time inspite of his busy schedule to review my work and gave me many useful and insightful points. The moral support he gave me made me believe it could be done. Dr Guy Barnish worked with me as a second supervisor and member of my advisory panel until his retirement. Contributions provided by him in the initial stages of my work greatly helped to shape this thesis.

Professor Moses Bockarie offered immense assistance by providing supervision and technical guidance since he joined the CNTD. His invaluable insights and suggestions, which helped with this write-up, are much appreciated.

To the entire team at the CNTD I wish to say thank you for your help, which came in various forms at different times of this long study period. Special mention of Lisa, who inspite of her condition and being on maternity leave continued to spend time to help me complete this work. To Joan, Sara, Louise, Maria, Rinki, Brent, Ben and Alison I say thank you.

Dr Mark Bradley of GSK helped me procure a new set of Bm14 and Og4C3 kits to complete my laboratory analysis of the blood spot samples to ensure that problems with these test kits were solved without unduly interfering with my academic progress.

Professor John Gyapong, has mentored me since I joined the Ghana Filariasis Elimination Programme as his deputy until I assumed leadership and control of the Integrated Neglected Tropical Diseases Programme. He was instrumental in arranging this PhD study. Aside the initial inputs into the ideas, proposal and fieldwork as my local academic supervisor he encouraged me through this long study period. Professor Daniel Boakye also arranged for the laboratory support from NMIMR and for this I am grateful.

I am grateful to the entire NTD Programme technical team and the laboratory support teams of the NTD Programme and the NMIMR Africa LF Support Centre for their invaluable contribution. They are Bright Alomatu, Samuel Odoom, Odame Asiedu, Abednego Yeboah, Kwadwo Frimpong, Irene Offei and Dziedzom De Souza among others. They provided excellent technical assistance in the field and in the laboratories. Their dedication and keen interest for careful specimen collection helped a great deal. Dominic Kobina of PPME/GHS also helped work on my data. The immense contribution of Botchwey the driver in all this cannot be overlooked.

To my immediate and extended families whose encouragement kept me going especially Professor Richard Biritwum who also provided technical inputs and guidance with my initial proposal, I convey my heartfelt gratitude.

All the data available for the thesis would not have been possible without the cooperation and participation of NTD endemic and study communities. The study area communities are particularly acknowledged for their excellent collaboration.

To all other people who contributed directly or indirectly to the completion of this thesis, whose names I have not mentioned here, I say a big thank you.

Finally to the Good Lord who gives strength, health, knowledge and the capability to complete a thesis, I say thank you.

Table of Contents

Chapter 1

Introduction

Chapter 1: Introduction

1.1: Distribution of Lymphatic Filariasis (LF)

Lymphatic filariasis (LF) or elephantiasis has become a household name in many endemic countries. It is a well known disease due to the disfigurement that it causes. The disease is found in the tropical and sub-tropical regions of Asia, Africa, Western Pacific and limited parts of Central and South America (Ottesen et al, 2008; WHO, 2006a).

LF is one of the major public health problems in many tropical countries. It is endemic in 83 countries where over 1.2 billion people are at risk of the infection (Ottesen et al, 2008; WHO, 2006a). Recent estimates suggest that at least 120 million people are infected with LF worldwide and may suffer from one form or other of the clinical disease (Ottesen et al, 2008). Some 106 million individuals are infected with *W. bancrofti* and 13 million with *Brugia malayi* and *Brugia timori* (Rao et al, 2006). The number of physical disabilities due to lymphoedema, hydrocoele and recurrent infections or to sub-clinical abnormalities of lymphatic and renal function is currently estimated at 43 million, with bancroftian filariasis accounting for almost 40 million of these cases (WHO, 2000). About 74 million people who are microfilaraemic and asymptomatic may have covert lymphatic and renal pathology. Almost 27 million men and 16 million men and women are estimated to be affected with hydrocoeles and lymphoedema or elephantiasis respectively. Those with lymphoedema or elephantiasis have accompanying recurrent episodes of acute adenolymphangitis (ADL) presently known as dermatolymphangioadenitis (DLA) (WHO, 2001a; Gyapong et al., 2005). Finally, another one million individuals are also documented to have concealed infections resulting in conditions such as topical pulmonary eosinophilia (TPE) (WHO, 2001). There are over 40 million people with LF in sub-Saharan Africa with some 400 million being at-risk of the condition.

The public health significance and social and economic costs of the disease globally as well as for Africa are obvious (Gyapong et al, 1996; Chu et al, 2010). The World Bank Report of 1993 estimated the global burden of LF at 850,000 DALYs lost. This represented 0.23% of the global burden of parasitic diseases (World Bank, 1993). Based on more recent knowledge of the epidemiology and distribution of the disease, however, this figure is likely to be a gross underestimate, especially in the light of new findings relating to incidence, duration and severity of acute adenolymphangitis (Gyapong et al, 1996). The Disability Adjusted Life Years (DALYs) lost due to LF disease is now estimated to be 5-8 million DALYs (Hotez et al, 2009).

The vision of the Global Programme to Eliminate Lymphatic Filariasis (GPELF) is to achieve elimination of LF by 2020 after ensuring that all endemic countries started implementing programmes by 2010. The GPELF therefore needed to take stock of its progress towards the achievement of these goals. The recent Global Alliance for the Elimination of Lymphatic Filariasis (GAELF) meeting in Seoul, South Korea presented an opportunity to undertake this assessment of the GPELF as the programme reached a halfway point (Addiss, 2010). This assessment followed the World Health Organization WHO recommended process towards interruption of transmission. This begins with mapping of the distribution of LF to identify areas for MDA, followed by a 5-year or more period of delivering MDA using the double drug regimen of albendazole and ivermectin or diethylcarbamazine (DEC) to identified endemic populations, and a period of surveillance culminating finally in determining the end point of MDA and cessation of transmission (Addiss, 2010).

The GPELF has made significant progress since its inception. Among the 83 originally identified endemic countries 10 (12.3%) did not need MDA, about 52 (64.2%) were undertaking programmes leaving 19 countries which were to start implementing MDA. Among the 52 implementing countries 37 had completed the minimum of 5 rounds of MDA in some of the implementation units (Addiss, 2010). The GAELF was able to annually reach an estimated population of about 570 million people with MDA with albendazole and ivermectin/DEC, though a total of 1.9 billion treatments were provided to 48 out of the 83 known LF endemic countries during the period 2000-2008(Ottesen et al, 2008). Recent statistics also indicate that there are presently 120 million infected individuals from 73 endemic countries with 1.393 people at-risk of the infection needing MDA (WHO 2012). Some 15 million people are estimated to have lymphoedema or elephantiasis with 25 million with urogenital swellings principally scrotal hydrocoeles (WHO, 2012).

Other landmark achievements under the GAELF include protection of an estimated number of 22 million people from LF infection and disease with economic savings of about $24.2 billion being made (Chu et al, 2010). A decline in microfilaraemia prevalence has been demonstrated in 131 sentinel sites after five rounds of MDA with 68 sites (63%) showing a 100% reduction in prevalence (Addiss, 2010).

Some 27 (33.3%) country morbidity management programmes have demonstrated marked reductions in acute attacks in persons living with elephantiasis or lymphoedema. Ancillary benefits of LF have also accrued by treating or preventing infestation of individuals with intestinal worms, scabies and pediculosis (Ottesen et al, 2008) due to the broad anti-parasitic activity of albendazole and ivermectin/albendazole (Mohammed et al, 2008).

In spite of the achievements of the GAELF, many challenges need to be addressed. There is a need to improve partnerships, improve financial, logistic and human resources and undertake research leading to refined implementation strategies. These challenges border on the need to ensure that all endemic countries are committed to the programme, the need to upscale to full geographic coverage in all implementing countries, surmounting the treatment barrier presented in *Loa loa* co-endemic countries (LFSC, 2003; Twum-Danso, 2003) ensuring effective treatment in urban areas, strategies for treatment within conflict and post-conflict settings (Hopkins A and GAELF 6, 2010), refining post-MDA surveillance guidelines and the need for clear and easy to implement procedures and guidelines for determining the end points for MDA (Addiss, 2010).

1.2: Distribution, Transmission and Prevention of Lymphatic Filariasis

LF is a disease caused by the adults of *W.bancrofti*, which causes some 90% of the disease, however, other filaria species causing the disease are *Brugia malayi* and *Brugia timori*. Adult worms live in the lymphatic system of human beings. There are no known animal reservoirs of W. bancrofti. The mosquito is the only known vector of this parasitic infection and is spread from one person to another is through the bites of various genera and species of mosquitoes. The mosquito becomes infected when it ingests the microfilaria from an infected person's blood. The mosquito is also able to pass on these parasites when it bites another individual following a cycle of development. This happens when the mosquito bites another non-infected person and the infective larvae pass through the skin of the other non-infected person and migrate to the lymphatic vessels. They grow into the adult macrofilariae within the lymphatic vessels where they are estimated to live for as long as 7-10 years (Hawking, 1967). During this period the adult worms mate, and female macrofilariae produce millions of microscopic larvae called microfilariae, which are released into the blood stream of the affected individual. Once these microfilariae appear in the blood, a mosquito that bites this person is capable of picking up the microfilariae for transmission to yet another person. The parasites within the lymphatic system cause the pathology, which results in chronic gross disfigurement. *W.bancrofti* microfilariae exhibit nocturnal periodicity and appear in the blood stream at night and they are thus available for ingestion and transmission by night biting mosquitoes. During the daytime they accumulate in the small vessels of the lungs, and hence there are few in the peripheral blood. This phase is adapted to allow the microfilariae to enjoy favourable physiological conditions provided by the increase in oxygen tension in the lungs, referred to as the 'oxygen barrier'. Microfilariae pass through the lungs by night but accumulate there by day (Hawking, 1967). The nocturnal periodicity exhibited by *W. bancrofti* facilitates transmission when the night biting vectors the rural *Anopheles* or urban *Culex* is available to ingest the microfilaria parasites (Pichon et al, 2004). This circadian cycle is observed in the tropics and sub-tropics while diurnal sub-periodicity is associated with the vector *Aedes* mosquito in urban settings.

LF is known to be a leading cause of permanent and long-term disability worldwide. Pain, disfigurement and sexual disability are recognised features of the disease (Gyapong et al, 1996; WHO, 1998) as well as the inability to work due to disability, which has negative economic impacts on their families and communities (Perera et al., 2007). An individual needs multiple mosquito bites over many months or even years to acquire active clinical LF (Centers for Disease Control and Prevention (CDC), 2012). This risk of infection with LF is greatest for people who live in the tropical and sub-tropical areas where the infection is common (CDC, 2012). An infection can be demonstrated in the blood of an infected person even when they have no symptoms and signs of the disease and these people are unaware that they have this infection (CDC, 2012). This could continue until the death of the adult worm. The disease is rarely known to be life threatening or a direct cause of mortality. However, the infection can cause permanent damage to the lymphatic system and kidneys leading to the collection of lymph fluid in the arms, breasts, legs and also genital area in men. This swelling is referred to as lymphoedema resulting in limb swelling up to several times the normal size of the leg, arm or genital area. The function of the lymphatic system in fighting bacterial infections is compromised leading to bacterial infections in the skin and lymphatic system. These cause hardening and thickening of the skin called elephantiasis (WHO, 2001a; 2001b).

Common conditions associated with the disease are poor sanitation and rapid growth of communities in the tropical and subtropical areas of the world. In these areas the disease is common since mosquito breeding sites are easy to find leading to more people becoming infected. Giving anti-filarial medicines to the entire at risk communities will reduce the microfilaria levels and hence reduce the risk of transmission. Controlling the mosquito breeding sites and avoiding the mosquito bites between dusk and dawn helps to prevent transmission and hence the disease. It is therefore recommended that people, who live in endemic areas sleep under mosquito nets, take the yearly dose of anti-filarial medicines to kill microfilaria circulating in the blood and even some adult worms (http://www.dpd.cdc.gov/dpdx/HTML/Filariasis.htm>(last accessed 28 April 2012). Application of in-door residual spraying as has been starte in certain parts of Ghana under the Presidents Malaria Initiative (PMI) should have the added advantage of aiding elimination of LF disease. Early studies in the Solomon Islands clearly showed that anti malarial measures-indoor residual spraying eliminated transmission (Bockarie et al, 2009).

1.3: Global Burden and Programme to Eliminate Lymphatic Filariasis

The GPELF had its beginning with an inauguration at the Royal Society of Tropical Medicine and Hygiene in London in January 2000. In May 2000 the first meeting of the GAELF was held in Spain. These initial activities became possible after several years of research into LF but limited efforts had been made to control this disease with the exception of some implementation activities in countries such as China, Korea, Sri Lanka and Thailand. With 83 countries regarded as endemic for LF at the time, national plans of action to eliminate LF by 23 endemic countries were drawn up leading to the successful initiation of programme implementation activities in 12 of these countries resulting in the treatment of about 3 million people (WHO, 2000). In Africa the total population at-risk of LF is estimated to be 408,429,756 in 39 countries, 18 of which are currently under MDA. Among these 18 countries 10 of them have completed 5 rounds of MDA implementation activities (WHO, 2010 a, b).

The initiative to eliminate filariasis was informed by decades of scientific research and investigations early control programmes in China, Costa Rica, Suriname and other countries whose experiences lead the International Task Force for Disease Eradication (ITFDE) in 1993 to suggest that LF was an "eradicable disease" (Centers for Disease Control and Prevention, 1998). During the past 13 years Ghana as a country and the focus of this thesis has greatly benefited from this global initiative. During this period Ghana has undertaken mapping resulting in an endemic map and developed a strategic plan of action, established baseline information and undertaken follow-up surveys in selected sentinel sites which have helped with monitoring in all the endemic regions, and is presently involved in designing an exit plan to help determine the end points of mass drug distribution in areas which have completed a minimum of 6 rounds of distribution. Some districts, in which the

Ghana programme has undertaken continuous microfilaria prevalence and density monitoring have shown significant reduction in microfilaria prevalence and densities to the expected low levels while others, remain a challenge. Also the programme has had striking impacts on the health system. It provided the platform for implementing other NTD programmes that rely on mass chemotherapy as a strategy.

The World Health Report of 1995 described LF as the second leading cause of permanent and long term disability (WHO, 1995). This was followed up in the World Health Report of 2000 where it was again said to be the second leading cause of lost 'disability adjusted life years (DALY's) (WHO 2000). The research findings of the 1980s and 1990s led to the declaration that LF was a potentially eradicable disease and also provided the impetus for the World Health Assembly Resolution 50.29 in 1997. This resolution had the support of the Ministries of Health of the endemic countries and other organizations such as the Arab Fund for Economic and Social Development, the World Bank and the United States CDC among others (WHO, 2000).

The 50th World Health Assembly resolution in 1997 (WHA 50.29) called on member states to work towards the elimination of LF as a public health problem by 2020 (WHO,2011a). Scientific knowledge, human, material and financial resources have been harnessed to see to realise this challenging goal. The WHA resolution sought to cover all endemic countries with elimination programmes by 2010 and aim a gradual reduction and ultimately interruption of transmission by 2020 (WHO, 2011a).

The two main strategies adopted were

(a) Interruption of transmission through MDA with annual single dose two-drug regimen to entire at risk populations for at least 5 years, and (WHO, 2006 a; WHO 2006b)

(b) Alleviation of disability through morbidity management of clinical cases (WHO 2007 a, b)

A major factor in the momentum to launch the GPELF was the commitment of SmithKlineBeecham now GlaxoSmithKline in 1998 to donate albendazole worldwide. Merck & Co Inc., pledged to donate ivermectin in all African countries co-endemic for onchocerciasis and LF for as long as it was required. A Memorandum of Understanding was signed between the Chief Executives of these companies with the Director-General of the WHO. This brought on board other major international organisations that pledged further funding to help realise the goals of this noble objective. A broad coalition of partners resulted after several other organisations joined the partnership, which was made up of some 27 organisations and national Ministries of hHealth of LF endemic countries (WHO, 2000). With interim monitoring guidelines, the programme was successful in treating 200,000 people from 4 endemic countries with the start-up programme (WHO, 2000). Governments of endemic countries have borne about 80% of implementation costs the GPELF was able to reach about half of the total global at-risk population (WHO, 2006).

1.4 Interruption of transmission

In the WHO 2001 LF report, to interrupt transmission of LF was defined as "reduction in the disease incidence to close to zero as a result of deliberate efforts requiring continued and coordinated activities" (WHO, 2001a, WHO, 2001b). This meant that the entire at-risk population had to be covered by MDA over sufficient time long enough to bring about this desired effect of interrupting transmission. The drugs that were recommended were DEC (6mg/kg) and albendazole (400mg) or ivermectin (150ug/kg) and albendazole (400mg). In areas co-endemic for LF and onchocerciasis, DEC -fortified cooking salt daily over a period of 6-12 months is another option that is available to endemic countries (Gyapong et al, 2005; Bockarie et al, 2009).

1.5 Lymphatic Filariasis in Ghana

The serious health and socioeconomic impacts of LF disease in Ghana has raised the public health awareness of the disease in Ghana (Gyapong et al., 1996). There have been various attempts to describe LF in Ghana over the years. In a study conducted through rapid community diagnosis of LF, key informants interviewed ranked scrotal swellings second and elephantiasis fifth among common conditions in adults in parts of rural Ghana (Gyapong et al., 1996). This study established a high correlation between rapid LF at the community level. Routine reporting at health facilities estimated hydrocoele surgeries to be among the commonest surgeries carried out in district level health facilities surveyed followed by hernias. District assembly members were able to provide reliable estimates of numbers of people with elephantiasis, which could be corroborated with data from the district health management team (DHMT). Data on hydrocoeles were largely underestimated because reports focused on cases of gross scrotal enlargements. Reports from teachers interviewed also gave estimates close to figures from the DHMT and similar to that by the district assembly members. Teachers reported a history of acute adenolymphangitis (ADL) among some of their class children. Adult males over 20 years had prevalence of hydrocoeles ranging from 4.1% and 19.8% (Gyapong et al., 1996). More than 50% of those examined had hydrocoeles with sizes bigger than a tennis ball. A marked correlation between the prevalence of hydrocoeles among males and the community microfilaria prevalence was established (Gyapong et al., 1996).

Surveys undertaken in Ghana also assessed the prevalence of hydrocoeles as a rapid diagnostic index for LF and established that it is possible to obtain a reliable and valid estimate of the community burden of LF using the prevalence of hydrocoeles as a diagnostic index. This study documented a positive and significant association between filarial disease prevalence and infection prevalence and intensity at the community level in Ghana (Gyapong et al, 1998). This was done by establishing the correlation between the prevalence of disease status associated with LF such as ADL, elephantiasis and hydrocoeles and microfilaraemia at the community level. The prevalence of the disease, especially hydrocoeles in Ghana was used to identify communities at-risk and predict the intensity of the infection without recommending its use in the monitoring of control programmes since prevalence and intensity of infection was not likely to be reflected in immediate reduction in disease prevalence (Gyapong et al, 1998).

Further studies described the epidemiology of LF in Ghana and established that the disease was a significant public health problem in Ghana (Gyapong et al, 1993, Gyapong et al, 1994, Gyapong et al, 1996) especially in northern regions and the coastal savanna requiring the design and implementation of a control programme. Another survey identified LF in 41 communities of north east Ghana. Several levels of the disease were identified in these hyper-endemic areas with two government-introduced rice irrigation projects. In these areas it was discovered that failure to control LF made patients avoid hospitals and neglect the disease, by both the sufferers and medical personnel (Hunter, 1992). The prevalence in the northern guinea savanna was greater than in southern coastal savannah while the middle forest belt was relatively free. For this study the national microfilaraemia was 3.0% and regional levels varied from zero in Brong Ahafo and Greater Accra regions to 20.0% in Upper West region. Infection was found to be present in 8 of the 10 regions of Ghana. The study also demonstrated an increase in microfilaraemia and other clinical disease manifestations such as acute adenolymphagitis, elephantiasis of the leg, hydrocoeles and lymphoedema of the breast with age. Males were also found to have higher microfilaraemia intensities than females (Gyapong et al, 1996).

Ghana was one of the countries in which the use of the grid sampling method was used for the rapid assessment of the geographic distribution of bancroftian filariasis. The study recommended the 50×50-km grid method as being adequate for this rapid determination of the prevalence of LF. The antigen detection test using the immunochromatographic cards (ICT) method was also found to be a better diagnostic test than the use of clinical examination for hydrocoeles or night blood films. Filarial antigen tests have been found to be more sensitive than parasitological tests, and are a species-specific filarial diagnostic test for *W. bancrofti* (Weil et al, 1997). This study therefore recommended that for rapid mapping of filariasis in Africa, the use of the 50-km sample grid, rapid assessment procedure (RAP) for antigenaemia in sample villages and spatial analysis to plot prevalence contours (Gyapong et al, 2001) should be the method to employ.

This mapping of LF disease in Ghana laid the groundwork for the commencement of a country elimination programme with the availability of tools and strategies including donated ivermectin and albendazole and the community-directed treatment approach for MDA for the control of onchocerciasis and LF in co-endemic areas. *Wuchereria bancrofti* is the causative agent of LF disease, and the female *Anopheles* mosquito the vector. Since the inception of the programme Ghana has gone through a national administrative re-demarcation of its district boundaries twice. The number of administrative districts in the country has changed from 110 to 138 and presently stands at 170 and with it, the number of LF endemic districts has also changed from 49 to 61 and now stands at 74. The total at risk population is, however, still projected at about 10 million of Ghana's total population of 24 million. Prevalence of the overt forms of the disease is between 0 - 4% for elephantiasis and 0 – 35% for hydrocoeles (Gyapong et al, 1998).

Ghana has completed the mapping of LF and completed 9 rounds of implementation activities during which time the programme pursued and completed a gradual scale up plan. These activities include planning and implementing mass drug distribution and morbidity control. It was estimated that the disease will be eliminated in Ghana by 2010 (Ghana Health Service, 2000), however, evidence presently available to the programme suggests otherwise. With this task are major implementation issues that require to be addressed. Significant among these are the ability to monitor the processes and impact of the programme on various health outcome and output indicators including coverage and microfilarial prevalence and intensity. Effective but essential monitoring will help determine the possible endpoint of programme implementation. During this period, the LF Elimination Programme has been merged with the Onchocerciasis Control Programme, and then later integrated with the Schistosomiasis and Soil Transmitted Helminths Control Programme. All these implementation activities are being undertaken under one programme management. Many aspects of the Trachoma Elimination Programme have also been integrated with the LF, onchocerciasis, schistosomiasis and soil transmitted helminths control.

Ghana operates the Primary Health Care System with emphasis on preventive services and basic clinical care at the health centre level. The Ghana Health Service is the main implementing body of the Primary Health

Care System, with assistance from organizations and non-governmental groups working in health. Administratively, the Ghana Health Service is organized at 3 levels, the national, regional and district levels. Preventive Health Services are provided and coordinated by the Public Health Division of the Ghana Health Services. Disease control programme implementation is under this division but operates through the regions, district, sub-district to the communities; (Government of Ghana, 2006).

1.6 Ghana Filariasis Elimination Programme

The burden of LF in Ghana has been documented extensively culminating in the countrywide mapping of the condition in 2000 in addition to three other West African countries (Burkina Faso, Togo and Benin) (Gyapong et al, 2002). Before the 1990's surveys conducted by scientists and hospital record data had helped to establish Ghana as being endemic for LF (Figures 1.1 and 1.2). Clinical reports had indicated that elephantiasis of the leg and hydrocoeles were common in northern areas and along the coastal belt west from Accra to the border with Cote d'Ivoire (unpublished reports). The Gold Coast Medical Report of 1937 had also indicated that filariasis was prevalent in the northern part of the country. Several other publications provide information on the endemicity of LF in Ghana (Hunter,1992; Dunyo et al, 1996; Gyapong et al, 1996a). Manifestations of LF in the form of elephantiasis and hydrocoeles with manifestations of ADLmanaged with antibiotics and analgesics have all been reported earlier, though the cause was never confirmed as being of infective origin or as a result podoconiosis (Davey et al, 2007).

Several studies were carried out, particularly in the 1990's confirmed the endemicity of LF in Ghana and prepared the ground for the Programme for the Elimination of Lymphatic Filariasis (PELF) in Ghana (Figure 1.1). Among these are studies undertaken in northern Ghana and as part of the Vitamin A Supplementation Trials Survival Studies (Gyapong et al, 1993) in which 12.6% of compounds visited had at least one resident within the compound with visible or reported elephantiasis of the leg (Gyapong et al, 1993). There were also observations of cases of elephantiasis in market places and medical reports of hydrocoelectomies forming about 20% of all surgical cases undertaken within district hospitals (Gyapong et al, 1995). Other surveys conducted demonstrated 41.1% microfilaraemia with *W.bancrofti*, 3.6% prevalence of elephantiasis and 30.8% of males with hydrocoeles (Gyapong et al, 1993) (Figures 1. and 1.2). Another survey revealed microfilaraemia prevalence of 32.4%, geometric mean density of 794 mf/ml for infected persons, elephantiasis prevalence of 4.6% of the study population and 32.2% of males with hydrocoeles (Gyapong el al, 1994). In the Western region studies showed microfilaraemia prevalence of about 10% in 15 sampled villages, elephantiasis prevalence of 5.2% and a hydrocoele prevalence of 17% among males (Ghana Health Services, 1999). Further parasitological studies also established the endemicity of filariasis along the coast of Ghana (Dunyo et al, 1996). The extent of distribution of the disease in the Ahanta West district of the Western Region was also carried out using rapid assessment methods which confirmed that the district had widespread LF disease (Hunter, 1992; Gyapong et al, 1996a).

Finally, a national prevalence survey was conducted to determine the prevalence and distribution of LF in Ghana (Ghana Health Service, 1999). A high prevalence of microfilaraemia and disease was demonstrated through these surveys. The disease was found to be of a much higher prevalence in the northern savanna areas (microfilaraemia prevalence between 20-40%) and the coastal savanna areas (10-20%) of Ghana. The forest belt within the central part of Ghana was relatively free of the disease. The survey also showed significant variations between regions and also within regions. These surveys confirmed that LF was a major public health problem in Ghana especially in the northern and southern coastal savannah and required the design and implementation of a control programme (Gyapong et al, 1996b).

In Ghana, filariasis has been shown to have grave socio-economic effects associated with social stigma with its severe debilitating effects on sufferers (Gyapong et al, 1996). Armed with the results of the national mapping exercise a national strategic plan of implementation was put in place for the elimination of LF from Ghana.

1.7 Neglected Tropical Diseases and Integrated Control

The Neglected Tropical Diseases (NTDs) are a group of disease conditions common in the tropics and sub-tropics that have been described as “ancient afflictions that have burdened humanity for centuries” (Hotez et al, 2006). These NTDs tend to be common infections that affect the poorest of the world’s populations causing chronic disability and disfigurement in these middle and low income countries worldwide (Hotez et al, 2007; Hotez, 2008; Hotez et al, 2009). They are also “poverty-promoting and are associated with stigma” (Hotez et al, 2006). They are found in rural areas even in these low-income countries (Hotez et al, 2006). In these areas the most at-risk people are children and women of child bearing age (Hotez et al., 2009). They reduce agricultural productivity eventually depriving these already vulnerable groups of good health and economic well-being. The cycle of poverty is what results for these populations estimated at 1.4 billion globally (Hotez et al, 2009).

The NTDs are parasitic, bacterial or viral diseases often spread by insects and other vectors such as mosquitoes, black flies tsetse flies and snails and associated with poor living conditions and lack of clean water and sanitation (WHO, 2010a). Contamination of certain environments by these agents such as soil contaminated with the eggs of worms, poor living standards, poor conditions of hygiene which are common in settings of extreme poverty, urban slums and areas of conflict or civil unrest (Hopkins A, GAELF 6, 2010; Hotez et al,2010) largely support and contribute to the transmission these diseases.

These diseases cause severe disability and life-long medical impairments. Their close linkage with poverty cause them to geographically overlap and cluster in areas where there is lack of potable water, poor personal hygiene, poor sanitation, poor housing and where the vectors that transmit these diseases are usually abundant.

The list of NTDs currently stands at about 17 according to the WHO and these include

1. Dengue
2. Rabies
3. Trachoma
4. Mycobacterium ulcerans infection (Buruli ulcer disease)
5. Endemic treponematoses
6. Leprosy (Hansen disease)
7. Chagas disease (American trypanosomiasis)
8. Human African trypanosomiasis
9. Leishmaniasis
10. Cysticercosis
11. Dracunculiasis (guinea-worm disease)
12. Echinococcosis
13. Foodborne trematode infections
14. Lymphatic filariasis
15. Onchocerciasis (river blindness)
16. Schistosomiasis (bilharziasis)
17. Soil transmitted helminthiasis

The burden of NTDs is enormous. On their own NTDs contribute to poverty particularly in sub-Saharan Africa (Molyneux et al, 2005). About 90% of the burden of disease due to the NTDs can be found in Africa with those having the highest intensity and prevalence being schistosomiasis, LF, onchocerciasis, soil transmitted helminthiasis, trachoma among others (Molyneux et al, 2005). NTDs contribute to an estimated 500,000 deaths annually with a DALYs equivalent of about a quarter of the disease burden for HIV/AIDS, and about 50% for malaria (Hotez et al, 2006). Reasons assigned for their neglect are many but among them is the fact that policy makers and public health officials have focused their efforts at the control of the "big three diseases (HIV/AIDS, tuberculosis (TB), and malaria)" (Molyneux, 2008), and devoted little or no attention to these diseases most of which are amenable to mass preventive chemotherapy (Molyneux et al, 2005).

The most common of these neglected diseases are STH (affects over a billion people worldwide), schistosomiasis (over 200 million infected), LF (over 120 million infected), trachoma (around 80 million infected) and onchocerciasis (about 37 million infected) are among the most prevalent NTDs globally (WHO, 2012). Interventions targeted at these diseases when applied have been successful (Molyneux, 2004; Molyneux et al, 2005, Molyneux, 2008). Among this group of neglected diseases are a sub-group with which marked reductions in prevalence and incidence have occurred in the last 2 decades. These include LF, onchocerciasis, and trachoma (Hotez et al, 2006; 2009). In spite of the enormity of the global burden of these diseases financial support for their control and elimination efforts has been limited until recently. Support for research and development in the field of NTDs have also been inadequate (Hotez, 2008; Moran et al, 2009). Development of new diagnostic tools, drugs and vaccines NTD control has not been forthcoming. The contribution of the NTDs to the attainment of Millennium Development Goal (MDG) 6 is not acknowledged since it receives no specific mention in the MDG document (UN, MDGs Report, 2009), although in recent years the G8 communiqués have referred to the NTDs through strong advocacy efforts (Molyneux, 2008; Molyneux, 2010).

Geographically they tend to be concentrated in low and middle-income countries in Africa, Latin America, Asia and Middle East. These diseases tend to be of limited priority in national health systems. They often overlap geographically resulting in situations where many people or communities are infected with more than one of the infections-polyparasitism. As a group of diseases they cause enormous economic and social burden to many countries (Conteh et al, 2010). They cause blindness, debilitation, deformation or maiming through subtle processes. The economic productivity of young adults in their prime of life is weakened, childhood growth and cognitive development is impaired resulting in social stigmatization and discrimination (Hotez et al, 2009). The severe disability often occurs after years of virtually silent infection, leaving patients unaware of the need to seek care. These diseases cause irreversible damage if not detected and treated on time. Other of the WHO classified NTDs-trypanosomiasis, rabies, visceral leishmaniasis-can kill within weeks or months once an advanced stage is reached are not treated in time often through misdiagnosis (Hotez et al, 2009).

Policy makers are now beginning to appreciate the importance of the NTDs as a public health problem of the world's poorest people (Hotez et al, 2009) and the contribution their control would make towards the achievement of the MDGs. After many years of neglect suffered by issues concerning these diseases and individuals who suffer these conditions, some progress has been made. Effective medicines are available and strategies defined for their treatment or prevention with the formation of public-private partnerships, drug donations made by ithe pharmaceutical industry who have made large quantities of these medicines available at no charge to endemic countries. Technical guidelines and tools for use by national programmes are being developed by WHO in collaboration with the private sector, non-governmental organizations, international agencies and other United Nations organizations (Grepin et al, 2008).

Landmark achievements have been made on the global front (WHO, 2010; Molyneux et al, 2011). The estimated number of people affected by blinding trachoma has been reduced from 360 million in 1985 to about 80 million presently. Onchocerciasis has been controlled in 10 previously highly endemic West African countries where it is no longer a disease of public health and socio-economic significance. The Onchocerciasis Control Programme has been successful in preventing about 600,000 cases of blindness and freed and secured 25 million hectares of land for agricultural purposes resettlement. The World Health Organization and its partners have recently launched the integrated strategy for fighting 4 of the highest-burden NTDs, which are onchocerciasis, LF and soil-transmitted helminthiasis. Large-scale use of safe and single-dose drug treatments namely preventive chemotherapy is the core of this innovative strategy. All 4 diseases are amenable to prevention using drugs that can be acquired at no cost or at a substantially reduced cost. These medicines are so effective and safe that they can be administered pre-emptively to all at-risk communities leaving out the need for case finding or diagnosis (Grepin et al, 2008).

The strategy of integration is one that could enhance implementation of the NTD control or elimination especially for those that are managed with mass preventive chemotherapy. Integration refers to the creation of linkages among existing programs to improve the delivery of health interventions given existing commitments and resources (Grepin et al, 2008). Common control activities and lower costs associated with scaling up provide strong reasons for integration of partnerships and can help improve efficiency and effectiveness with one of its major advantage being cost savings (Brady et al, 2006, Lammie et al, 2006, Hotez et al, 2006). With integration, joint activities of separate programmes are carried out together and coordinated centrally. These include joint drugs distributions, multi-disease evaluations or joint training sessions for community distributors. In terms of policy, joint advocacy development and implementation, assessment of needs and disease priorities for a combination of specific disease programmes, technical and financial guidelines development and programme activity coordination are probable areas for integration. Further policy integration could involve development of multi-disease indicators and well coordinated incentive structures for community distributors (Grepin et al, 2008). With regards to the organisational structures of the integrated programme the single or specific disease programmes could be merged into a one entity or forming a new organizational structure to embrace activities of all the programmes being integrated. Organisational integration would involve the formation of a new partnership for community-based distribution or the merging of one disease programme with another where one disease programme has a clear comparative advantage over the other and assist harmonization and synergy (Grepin et al, 2008).

Integration can therefore occur at several levels of the health system. The costs and benefits of integration would depend on the level at which it is integration is taking place. These may include the global level, national or regional level as well as the local levels that could be the district, village or community. Global level integration is one, which occurs between international partnerships and other international health organizations involved in financing, planning, and implementation of disease-specific programmes. Examples are major Public Private Partnerships (PPPs) working in a joint collaboration for the development of multi-disease evaluations within the policy domain (Widdus, 2005). Nationally or regionally integration could

happen between national or regional disease-specific programmes, Non-Governmental Organizations (NGOs) and other national or regional partners as could be found among programme coordinators or coordination of activities at the national level in order to guide activities at the lower levels of the health system which are the regional, district and community levels (Grepin et al, 2008).
Locally at the district, village or community levels integration within the NTD programmes could occur between health workers, NGOs, community volunteers and relevant community based partners. The ability for districts to combine training sessions for community distributors into a single training session is an example of integration at the local level (Grepin et al, 2008). The degree to which integration occurs depends on its operationalisation. This could happen though either through coordination, collaboration or consolidation (Grepin et al, 2008). Coordination will involve "information sharing or communication among separate programmes for the purpose of simplifying implementation of the respective programme". This often happens with programmes working together at the national level to develop an annual implementation plan. Increased cooperation among disease-specific programmes happens with collaboration. There is sharing of resources or personnel and multiple programmes join together to procure vehicles and other equipment that are used by all the programmes. Consolidation occurs when actual implementation of portions of an entire programme is taken over by another programme. The replacement of a multiple single-disease training sessions with a single once a year training session for multiple-disease programme typifies a case of consolidation (Grepin et al, 2008).

The benefits of integration for the future of NTD Programme implementation are immense. As the opportunities of undertaking integrated NTD control programmes are being exploited for the good of these "neglected populations" the challenges of integration should also be carefully addressed to ensure optimisation of the benefits of integration to NTDs. Integration is able to improve delivery of NTD control programmes in resource-poor settings in sub-Saharan Africa in delivering health services in an efficient and cost-effective way (Grepin et al, 2008). An example of integration at the global level is demonstrated by the collaboration for research between the Gates Foundation and organizations like Schistosomiasis Control Initiative (SCI), CDC and the Carter Centre among others. The WHO also is responsible for the broader policy recommendations and has coordinated the production of guidelines for countries including the integrated guidelines for the development of national integrated control (WHO, 2006c)) working in collaboration with other academic and research institutions. The African Programme for Onchocerciasi Control (APOC) has also offered technical coordination support to countries for the development of national policies on integrated control of NTDs (Hodgkins et al, 2007). At the local level harmonised incentives for community drug distributors, which present a huge challenge to many health programmes, is another area for improved integration between NTD programmes and communities (Grepin et al, 2008).

The value and need for integrated control of the NTDs is because these diseases exhibit geographical overlap (Molyneux et al, 2005) and affected individuals “exhibit polyparasitism” (Raso et al, 2004, Fenwick et al, 2005) where one individual harbours more than one parasite. The need for countries to coordinate and integrate NTD control activities is imperative. Also many of the drugs employed for chemotherapy are capable of treating other conditions in addition to those they are specifically targeted against (Rao et al 2002; Heukelbach et al; 2004, Lawrence et al, 2005; Taylor et al., 2005). Integration brings about increased cost-effectiveness (Conteh et al, 2010) with PPPs internationally involved with the different diseases to coordinate their in-country efforts to achieve treatment of several conditions. With co-ordination, efforts at employing ivermectin, albendazole, praziquantel, and azithromycin through some six PPPs involved in their distribution could impact morbidity, blindness and skin diseases at minimal costs (Fenwick et al, 2005).

Several challenges of integrated control of these neglected tropical disease that require attention are possible development of drug resistance requiring further drug development research, feasibility of integrating several different vertical control programmes, the political difficulty of convincing PPPs to work together through cooperation and integration of their control activities (Widdus, 2005, Brady et al, 2006; Kabatereine et al, 2010). Treatment costs of delivering the rapid impact package aimed at the 7 NTDs (schistosomiasis, trachoma, LF, onchocerciasis, hookworms, tricuriasis and ascariasis) (Kabatereine et al, 2010) is minimal compared to cost of treatment provided for other similar public health interventions. A greater impact in terms of reduction in stigma, disability, morbidity and mortality that is a quicker and more cost effective means of reaching the MDGs (Molyneux, 2008; Grepin et al, 2008) is achieved.

1.8 Preventive Chemotherapy (PC)

The drugs often employed for mass treatments involving LF, onchocerciasis, schistosomiasis, soil transmitted helminths and trachoma are ivermectin, albendazole, mebendazole, praziquantel and azithromycin respectively. Preventive chemotherapy (PC) and transmission control is a strategy that has been developed to help prevent, control, eliminate or even eradicate this group of neglected tropical disease which can be addressed with mass treatment using "safe and effective drugs". Mass preventive chemotherapy campaigns are employed for the treatment of whole communities identified to be endemic for particular diseases such as LF, onchocerciasis, schistosomiasis, soil transmitted helminthiasis and trachoma (WHO, 2006c).

Treatment is targeted at the eligible population within the communities rather than infected individuals. Such treatments have the objective of conferring protection on whole communities against infection rather than treating individual members of the community. For such communities the disease prevalence should be above a certain threshold and would not require subjecting individuals to initial clinical or laboratory investigations. These drugs are therefore administered on a large scale, in a coordinated approach, without individual diagnosis in an identified endemic area. Due to different disease overlaps and the need for coordination a designed treatment algorithm is always required (WHO, 2006c).

The main objective of the Ghana LF elimination plan was to initiate and implement a programme of activities aimed at controlling and eventually leading to the elimination of the disease as a public health problem from Ghana (GHS, 2000).

1.9 Specific objectives to eliminate lymphatic filariasis in Ghana

1. To improve knowledge in endemic communities on the cause and transmission of LF through the use of appropriate information, education and communication (IEC) methods
2. To reduce and finally break transmission of LF through mass administration of antifilarial drugs
3. To reduce morbidity associated with LF through appropriate clinical and home management of hydrocoele and elephantiasis

The main strategies that were adopted for control and elimination of LF were mass treatment of the human population to break the transmission cycle of the infection followed by morbidity control to alleviate the suffering of those affected by the disease and reduce morbidity and pathology. These strategies were integrated into the health system and pre-existing control programmes aimed at other public health problems such as onchocerciasis and intestinal parasite infections. Vector control was not proposed as an integral part of this control programme but was to be advocated for to be linked with the malaria control programme, which focused on bed net distribution. Opportunities for integration of insecticide treated nets with filariasis as a national policy was explored as part of vector control efforts without initiating or being at the forefront of vector control to prevent duplication of malaria control activities. MDA was carried out in accordance with the WHO recommended strategies. These strategies were not based on selective treatment of infected individuals who were microfilaraemic but treatment was to eligible individuals in entire endemic populations using ivermectin and albendazole since Ghana is co-endemic for onchocerciasis and LF (WHO, 2000). The strategy of PC is employed for LF, onchocerciasis, schistosomiasis, soil transmitted helminthiasis and trachoma control among others (WHO 2006). Though diethylcarbamazine (DEC) was the main drug employed for treating LF in endemic countries particularly in Asia it was not recommended for those countries that were co-endemic with onchocerciasis due to the severe reactions they could elicit (WHO, 2008). Ivermectin (200µg/kg) and albendazole (400mg) as a single dose are given annually in countries coendemic for LF and onchocerciasis.

A second important component of the plan was morbidity control involving clinical management of individuals with overt clinical filarial disease. This required identification of people with lymphoedema or elephantiasis and hydrocoeles, training of the communities and individual patients on the appropriate care of the elephantoid limbs and hydrocoeles surgery for men with hydrocoeles. Centres where the surgeries could be done and surgeons needed to be identified, while community health workers were to be trained to provide training for affected communities on lymphoedema management. The disease control team was to work with the communities to demonstrate the proper care of the elephantoid limbs while affected people were encouraged to form elephantiasis management clubs to share experiences with each other on the washing of the limbs.

A team of surgeons with adequate skills for undertaking hydrocoeles surgeries were to be mobilized to undertake outreach visits to selected districts centres with the equipment and infrastructure for surgery on affected men mobilized from endemic district communities. Information, Education and Communication (IEC) strategies involved the development of health education materials with the help of feedback from communities and to provide them with information on the cause, transmission and control of LF. Improved participation of communities in the programme was expected from the communities through an understanding of the various methods of delivering this strategy resulting in health education materials and training manuals better tailored for use by the programme. A social scientist was identified and employed to coordinate the IEC activities.

Within the scope of the initial strategic plan for the control and elimination of LF several activities including baseline data collection for monitoring of infection within endemic populations was undertaken, after completion of mapping creating an LF endemicity map for Ghana. Yearly clinical, parasitological, immunological, and entomological assessments were carried out in sentinel and randomly selected sites as part of the monitoring processes. Management and support systems for programme implementation were provided from the national, regional and district levels of the health service. At the national level a secretariat was established at the Ghana Health Service while technical support was sought from the Noguchi Memorial Institute for Medical Research since these institutions have been involved in research activities on LF in Ghana providing the critical baseline data for the Programme. A Programme Management team led by a Programme Manager, an epidemiologist and a public health physician, a social scientist with expertise in health education, a data manager and a GIS specialist and other technical officers with responsibility for directing, implementing and supervising the programme from the national level was established. Each endemic region appointed a regional coordinator to coordinate implementation of the programme in the region. These regional coordinators were often the Regional Disease Control Officers who worked under the direct supervision of the Deputy Regional Directors in-charge of Public Health (DDPH). At the district level the District Disease Control Officer had the responsibility for coordinating the programme under the supervision of the District Director of Health Services (DDHS). At all levels of the regions and the districts planning, coordination and integration of the programme of activities were undertaken including organizing drug distribution and coordination of morbidity control and public education within their catchment areas.

Three levels of cascaded training were used to build capacity for filariasis control and also disease control in general. They were the regional and district level training of trainers for the health staff followed by sub-district level training for community drug distributors.

Monitoring and evaluation of all activities was carried out using a checklist developed for each activity drawing on the experience of other disease control programmes within the Ghana Health Service. Planned supervision of drug distribution and morbidity control activities in randomly selected communities was carried out. Monitoring and evaluation of selected parasitological and immunological indicators have been carried out since the inception of the programme. MDA coverage reported to the programme has been monitored with coverage surveys. The details of monitoring and evaluation of the programme through longitudinal and cross-sectional surveys will be discussed in subsequent chapters.

1.10 Implementing the Lymphatic Filariasis Elimination Programme in Ghana

The Ghana Lymphatic Filariasis Elimination Programme (GFEP) was established in June 2000. Mapping of the LF in Ghana identified 41 endemic districts, which were selected for elimination activities (Gyapong et al, 2002). There were 8 borderline districts, which were added on to make 49 in order to ensure the programme's aim of total elimination could be achieved. Recent re-demarcations of the district boundaries have increased the number of endemic district from 49 to 61 and then recently to 74 (ghanadistricts.com, 2010).

In order to improve knowledge in endemic communities the programme developed various activities that included

1. Training programmes at the regional, district and sub district levels of the programme to equip health workers and community drug distributors with the knowledge to enable them undertake sensitization of endemic communities
2. At the community level community meetings were held to provide information to the community members on the disease, the availability of tools for managing the condition and management of lymphoedema, hydrocoeles and the importance of mass treatment of endemic human populations

3. The national level undertook design and procurement of additional tools for undertaking sensitization and social mobilization for implementation of drug distribution. These tools were posters, flyers, morbidity control manuals and newly developed and designed flip charts for teaching limb washing.
4. Posters, flyers and morbidity control manuals were distributed to the regions for onward distribution to districts, then finally to the sub districts and communities for use.
5. Radio programmes were used to provide health education to the endemic communities as part of the social mobilization strategies.

1.11 Study Rationale

The World Health Assembly resolution (WHA. 50.29) for the elimination of LF as a public health problem from endemic areas set in motion a series of global, regional and country activities aimed at ensuring the achievement of this final goal. In line with the proposed strategies for LF elimination, Ghana's country programme undertook mapping of LF to establish the endemicity of the disease in Ghana. This was followed by programme implementation activities such as MDA with ivermectin and albendazole, morbidity control and monitoring and evaluation.

This thesis assesses the achievements made to date of the LF programme and its relation to NTD programme evolution in the context of the different levels of the health system.

In Ghana available WHO guidelines and technical support have been followed for mapping, programme implementation and monitoring and evaluation. Ivermectin and albendazole, praziquantel and mebendazole have been made available to endemic communities for the treatment of LF and other neglected tropical diseases. Many operational research activities have been undertaken to determine the impacts through process, outputs and outcomes indicators. This study therefore determined the impacts of the LF programme on recommended programme indicators and documented the impacts on the other preventive chemotherapy NTDs and the health system.

Prior to setting up country programmes, endemic countries were supported to map out the disease using the antigen card tests (Weil et al, 1997). They were then further supported to draw up implementation plans for LF elimination activities after completion of the mapping exercise. In order to follow the progress of elimination programmes impact studies are conducted in selected sentinel sites by elimination programme. However, lack of human, material and financial resources in the face of programmes up-scaling plans has resulted in modifications to the original strategies and plans for monitoring and evaluating the performance of the programme. In spite of all the challenges experienced in the elimination process, the programme has reported significant gains in reducing microfilarial load in endemic areas after completing several rounds of treatment. Targeted coverage of about 80% of total population has eluded some programme areas due to challenges with MDA. Some programmes have also reported significantly higher coverage of greater than 80% of their total endemic population. It was therefore, important to objectively and independently assess the impact of multi-drug treatment in endemic districts and at various stages of programme implementation, using available impact assessment tools, in order to study the reduction in parasite prevalence or density against the reported coverage and surveyed coverage. In doing this, an attempt was made to estimate the end point of Ghana's elimination programme by using the epidemiological assessment tools and methods for determining the end point of programme implementation.

Several technical groups and committees have suggested building synergies between public health programmes as a way of sustaining the programmes and exploring the possibility of integration of programmes. The Onchocerciasis Control Programme also employs mass treatment of endemic communities with ivermectin (Mectizan®) as a control strategy similar to the LF Elimination Programme. The Trachoma Control Programme distributes antibiotics using the Community-Mass Treatment approach that is employed by the LF Programme. The Soil Transmitted Helminthiasis control programme uses albendazole, one of the drugs employed for mass treatment by the LF Elimination Programme. Formerly, these programmes operated independently of each other in Ghana with duplication of functions and costs. As part of the impact assessment for the programme, possible synergies and opportunities for integration have been studied.

The LF Elimination Programme was implemented as a specific disease control programme since its inception in the year 2000. However in 2004, this programme was merged with the Onchocerciasis Control Programme in Ghana. These two programmes were co-implemented and integrated into the health system. In 2006, the NTD Control Programme was conceived, a plan of work was drawn up, a stakeholders meeting held to discuss the programme's plan of work; implementation of the programme started in February 2007. The integrated NTD Control Programme which manages and coordinates LF, onchocerciasis, trachoma, schistosomiasis and soil transmitted helminthiasis has been in place since 2007.

The LF Elimination Programme therefore provided the platform for implementation of the NTD Control Programme in Ghana. During this period the Onchocerciasis Control Programme was re-launched, the schistosomiasis and the soil transmitted helminths control programme was launched in collaboration with the School Health Education Programme of the Ghana

Education Service and given a national character. The Trachoma Elimination Programme was implemented under the Eye Care Division but, however, some activities were planned and co-implemented together. This study and thesis documents co-implementation of the LF Elimination Programme with the Onchocerciasis, Schistosomiasis and Soil Transmitted Helminths Control under the umbrella of the NTD Control Programme stressing that the NTD Programme is fully integrated into the national health care plan.

1.12 Hypothesis for Current Study

This study tested the hypothesis that applying the current MDA strategy with the minimum expected coverage rate (65%) of the total population will not achieve interruption of LF transmission within the period proposed by WHO (4-6 years) but will have significant impact on LF and on other NTDs targeted by preventive chemotherapy and transmission control and the health system.

1.13 Objectives

The main goal of this study was to determine the impact of MDA on the prevalence and transmission intensity of LF and investigate the suitability of the community-directed approach as a vehicle for developing an integrated treatment strategy targeting other NTDs amenable to MDA.

The specific objectives are

1. To determine the impact of anti-filarial drug treatment on antigen prevalence and microfilarial prevalence, density and load in selected communities and districts.

2. To determine the impact of drug treatment and morbidity management on affected individuals by investigating the change in quality and quantity of morbidity in selected communities in 5 endemic districts.
3. To determine the endpoint of MDA in 5 selected districts by monitoring for new infections among children less than 5 years.
4. To undertake a longitudinal comparison between reported and surveyed treatment coverage since the inception of the PELF for disease specific and integrated surveys conducted under both the lymphatic filariasis elimination and the integrated NTD Control Programme.
5. To undertake a compliance study with selected communities endemic for LF.
6. To determine the Knowledge, Attitude and Practices (KAP) to LF and its elimination and for other preventive chemotherapy diseases in Ghana.
7. To determine the impact of LF control programme on other NTDs such as onchocerciasis and schistosomiasis and the health system in Ghana.

The study focused on the process from inception of the LF Elimination Programme, monitoring its implementation through surveys and determination of the impact of the programme both on parasitological and antigenic indicators of the microfilaria worm and also its impact on the NTD Control Programme. An attempt to determine the possible end points of MDA, which would signify interruption of *W. bancrofti* transmission on the programme, will be undertaken. Process, outcome and output indicators for the programme were identified, analyzed and applied for the discussion in this thesis.

Chapter 2

Literature Review

Chapter 2: Literature Review

2.1 Introduction

Filarialial diseases are a major cause of acute and chronic morbidity in the tropical and subtropical parts of the world. The availability of safe, single-dose, drug treatment regimens capable of suppressing microfilaremia to very low levels, along with improvements in techniques for diagnosing infection, has resulted in the adoption of this major mosquito-borne disease for global elimination of LF (WHA 54.9). The GPELF was launched in 2000 with the principal objective of breaking the cycles of transmission of *W.bancrofti* and *Brugia spp.* through the application of annual MDA to entire at-risk populations. Although significant progress in initiating MDA programs in endemic countries has been made, emerging challenges to this approach have raised questions regarding the effectiveness of using MDA alone to eliminate LF without the inclusion of supplementary vector control.

2.2 History of Lymphatic Filariasis and other filarial worms

The story of LF spans several decades and continents through the work of many scientific scholars. Several species of insects and also worms were studied and have made significant contributions to this story leading to the eventual discovery of the definitive parasite and intermediate hosts along with vivid description of the disease state and presentation. The roles played by different organisations and institutions in packaging this knowledge into a global control effort, which could lead to the eventual global elimination of LF disease remains in sight.

The microfilaria or the larvae of the adult worms which cause LF was first described in 1863 by M. Demarquay. The parasite was found in human hydrocoele fluid from an individual in Havana, Cuba. He called the worms embryos because they did not have any internal organs. Manson also found and described an inch long worm that swam in water with purposeful and snakelike movements. Being convinced that these organisms were transmitted through drinking water, he said the worms escaped from the body of the mosquito when they fell in the water and were passed on to humans when they drank the water to cause the disease. However, in 1900 GC Low and S. P. James disproved the above thoughts though another scientist called Cobbold held on to similar views.

Manson in 1883 tried to describe the transmission of the filarial larva and indicated that these larvae were deposited in humans during the act of biting by the mosquito. The first male filarial bancrofti was described in 1888, though female filarial bancrofti had already been described. This male filarial bancrofti was found in material sent to India by Sibthorpe (Sibthorpe, 1888). About 16 years elapsed during which period very little was reported on *Filaria bancrofti*. However, Guitera found *Filaria sanguinis hominis* in chyluria of 4 Cuban cases in the US. Chyluria and filaria infections were found in persons living in Charleston, South Carolina in people who had never left this area. Information available suggested that the parasite occurred extensively in southern US. Mastin provided further information in 1888 to also emphasise the fact that Filaria sanguinis hominis was widespread in the southern states or the south Atlanta and in the Gulf Coasts. In these areas the lymphatics were the principle sites where the disease manifestation was found. Symptoms described included chyluria, lymphscrotum and elephantiasis of the scrotum (Indian Medical Gazette, 1940).

Many scientists continued to work on filaria disease. Maitland in 1894 wrote about a case of filarial disease of the lymphatics in which the adult filarial worm had been removed from the arm and chest. In British Guiana, Daniels and Conyers in 1896 reported the incidence of the manifestations of filariasis varied in different races, which inhabited the colony. They also noted that a proportion of elephantiasis patients had microfilaria in their blood and were also able to say that attacks of lymphangitis were more frequent in the rainy season and also that trauma to the affected limb tended to lead to an attack of lymphangitis.

Henry also described enormous distention of the lymphatics of the urinary tract and sometimes the thoracic duct in persons dying of parasitic chyluria in 1896 in Columbia, South Carolina. Daniels (1898) in British Guiana said the common geographic distribution of elephantiasis and Filaria bancrofti meant that elephantiasis was caused by filarial bancrofti. Another finding by Manson in April 1897 was a female filaria that emerged from a small tumor he excised from West Indian. This parasite survived for a period of 12 hours in normal saline. He also showed that blood microfilaria abounded in blood at night. Autopsies conducted on people who had committed suicide found greater numbers of microfilaria in lung capillaries, malpighian tubules of the kidneys and lymphatic cysts of the retroperitoneal tissues.

In 1900 Lethrop and Pratt were able to classify the presentation of filariasis as follows;

- Enlarged lymph glands or varicose groin glands
- Dilated lymph vessels, lymphangiectasis or lymphatic varix
- Rupture of dilated varices giving rise to chyluria, chylocele, chyluous ascities and chylous diarrhoeas
- Cutaneous lymphatic obstruction presenting as oedema, lymph scrotum or vulva and mostly as elephantiasis
- Secondary pyogenic infections such as cutaneous lesions, lymphangitis, cellulitis and abscess

Other scientific findings led to the description of the causative agents. J. H. Salisbury found certain ova in urine he referred to as new and distinct species of nematodes. In a second patient he found ova, which were not associated with haematuria but instead milky urine with granular cystine which was dense and scanty. Dr. T. R. Lewis in 1872 discovered minute filariae in human blood and also microscopic worms in blood and also in urine in persons suffering from chyluria. Dr. Prospero Sensino made further discoveries. He found filariae worms in the blood of a young Egyptian boy. In the same boy he also found filaria worms in urine and that of another patient. Dr. William Roberts in May 22, 1876 confirmed some of the earlier observations of Dr. Bancroft and Dr. Roberts.

Discovery of the adult worm was made by Dr. Bancroft in 1876. He directly associated the finding of worms in patients with chyluria, haematuria, spontaneous lymphatic abscess, a peculiar soft varix of the groin, a hydrocoele containing chylous fluid and forms of varicocoele and orchitis. He also found cases of elephantiasis of the leg, elephantiasis of the scrotum or lymph scrotum and concluded that these findings were also associated with the filarial parasite. The parasite as found by Bancroft was published in the 'Lancet' and named Filaria Bancrofti.

2.3 Mosquito as a Vector

Dr. Patrick Manson announced the discovery of larvae of filarial sanguinous hominis in the stomach of mosquitoes in Jan 4, 1878 and then on March 7, 1878, Dr Spencer Cobbold communicated a detailed account of Dr. Manson's investigation. He indicated that filaria underwent metamorphosis within the mosquito. He reported in the paper that the female mosquitoes after gorging itself with human blood went to stagnant water to digest the blood and deposit its eggs. The duration of this period was 4-5 days when filariae also underwent remarkable changes. They then incorrectly indicated that they escaped into water and were transmitted to humans when they drank this water. Within the human being further development happened to the filariae ending in sexual maturity of the parasite. Fertilization between these sexually mature forms of the parasite resulted successive swarms of the embryo, which were discharged by the female.

2.4 Discovery of the Adult Worm

The adult parasite was discovered on December 21, 1876 by Dr. Bancroft and verified on August 7, 1877 by Dr. Lewis, on October 16, 1877 by Dr. Silva Aranjo, on November 12, 1877 by Dr. F. Dos Santos in conjunction with Dr. J de Moura using a case of lymphatic abscess of the arm. Dr. Aranjo found the adult and embryonic filariae in the same patient who also manifested other disorders such as chyluria, craw-craw, lympho-scrotum and scrotal elephantiasis. These disorders used to be found separately but were found together by Dr. Aranjo and attributed to Wucherer's embryonic filariae. A number of affections or conditions, which, used to be regarded as distinct but were caused by the presence of filariae were regarded by Dr. Bouret-Ronchiere as different of one and the same disorder or condition. This was termed as Wucherer's helminthiasis. Description of the developmental stages of Filarial Bancrofti was reported in the Lancet of June 22, 1878 by Mr. D. H. Gabb of Hastings. The finding was summarised as follow;

1. Filaria bancrofti is the sexually-matured stage of certain microscopic worms hitherto obtained either directly or indirectly from human blood
2. Wucherer's Filaria, Filaria sanguinis hominis, Trichina cystical, Filariaose dermathemaca are frequently associated with the presence of certain diseases of warm climates
3. Chyluria, intertropical endemic haematuria, varix, elephantiasis, lymph scrotum and lymphoid affections referred to as helminthoma elastic, cutaneous disorder called craw-craw and leprosy

2.5 Pathology and Pathogenesis of Lymphatic Filariasis

Although LF remains among the major causes of disability among the tropical infectious diseases, dramatic advances have been made in the approach to its diagnosis, epidemiology and treatment, the molecular composition of the parasites that cause these infections, and in the factors underlying the pathology seen (Nutman, 2001).
In order to establish the infection in an individual many infective bites over several months to years are required. The natural course of infection as well as experimental infections of "volunteers" suggests that the filarial parasites are not inherently aggressive infectious agents. Experimental infections of humans with infective larvae result in transient, low-level microfilaremia, if at all. Non-endemic individuals with limited exposure show no evidence of persistent infection or pathology. Non-endemic individuals exposed to repeated infections show accelerated pathology. Normal, immune-competent residents in an endemic area show either (a) no pathology (endemic normals) because they are subject to the relatively low levels of infection or (b) chronic pathology if they are repeatedly infected. It appears that only those individuals

rendered immunologically tolerant to filarial parasites become productively infected with the filarial parasites. The intensity of transmission may underlie the differences in clinical presentation seen in diverse global pockets of endemicity (Rajan et al, 2005).

Poor sanitation and rapid growth in tropical and sub-tropical areas of the world resulting in more mosquito breeding sites in the tropics and sub-tropics has resulted in more people being infected with the disease. Preventive measures include mass treatment of entire endemic communities with medicines that kill the microfilaria. The other strategy is to incorporate vector control as a part of the elimination programme. The mosquitoes that transmit *W.bancrofti* bite at night and peak biting time is between 2200 hours and 0200 hours. Preventive measures that are employed include the use of insecticide treated nets and participating in the annual MDA with ivermectin and albendazole (in areas where onchocerciasis is co endemic with LF) which kill the microfilaria in the blood stream. While these drugs do not kill the adult worms reducing the numbers of circulating microfilaria prevents transmission of the infection.

2.6 Vectors of Lymphatic Filariasis

The vectors of *W.bancrofti* are mosquitoes. Several mosquito vectors are capable of transmission but geographic location determines the vectors responsible. In Africa the commonest vector is *Anopheles* species, while the *Culex*, *Aedes* and *Mansonia* transmit the disease in Asia and the Pacific (WHO, 1992). The geographic distribution of the agents of LF tends to be quite wide. While *W.bancrofti* is found throughout the tropics, *Brugia malayi* is limited to Asia and *Brugia timori* is only found in Indonesia. Many infective mosquito bites over months to years are required to establish the infection with *W.bancrofti* or other filarial parasites. The risk of acquiring the infection among short-term visitors to endemic areas is low. Transmission of

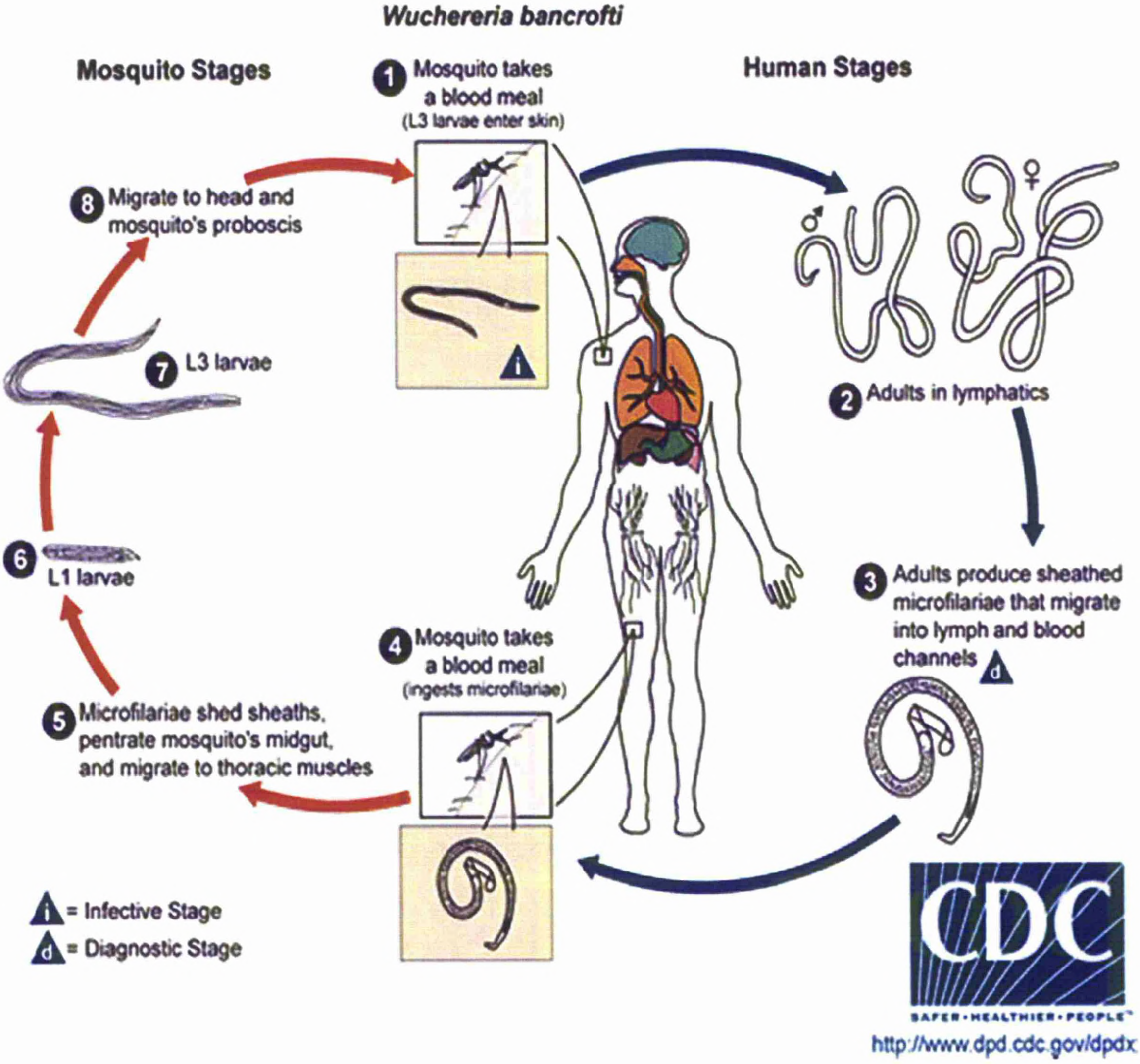
W.bancrofti due to the availability of the vectors, parasites and infective larvae in all months of the year emphasizes the risk of transmission exists throughout the year (WHO, 1992).

2.7 Life Cycle of Filarial Parasites

Three main parasites are responsible for LF in humans. These parasites are *W.bancrofti, Brugia malayi and Brugia timori*. While the majority of the infections found are caused by *W.bancrofti*, infection with *B. malayi* and *B.timori* are found only in Asia. Other known filaria worms include *Onchocerca volvulus, which* causes onchocerciasis *Loa loa*, *Mansonella perstans, Acanthocheilonema streptocerca,* and *Mansonella ozzardi* (Ottesen 2006; Bockarie et al 2009).

LF is a parasitic disease caused by a microscopic thread-like worm associated with the lymphatic system. The adult worm can only live in the lymphatic system. This disease is spread through the bite of an infected mosquito. When the mosquito takes a blood meal from a subject infected W.bancrofti, microfilaria circulating in the blood enter the mid gut of the mosquito. After a period of between 7-12 days following a period of development the infected mosquito bites another person and the infective L3 stage of these parasites are deposited onto the skin and enter the blood stream after penetrating the skin. This involves the microscopic L3 passing from the mosquito through the skin and reaching the lymph vessels. In the lymph vessels the larvae grow into L4 adults, which can live for up to an estimated seven years. The adult worms are capable of mating to release millions of microscopic microfilaria into the blood stream. Adult worms live in the lymphatic vessels and lymph nodes. *W. bancrofti* exhibits a nocturnal diurnal subperiodicity. They tend to be evenly distributed throughout the blood stream at night, making them available for ingestion and transmission by the mosquitoes. During the day-time they accumulate in the small vessels of the lungs with few of the parasites in peripheral blood (Ottesen, 2006).

Figure 2.2: Life Cycle of *W.bancrofti* (CDC, 2009)



2.8 Clinical Manifestations and Diagnosis

LF is a leading cause of permanent and long-term disability. Affected individuals suffer pain, disfigurement and sexual disability. It is stigmatising with those affected often being shunned by members of their communities. Those with visible signs of the disease are not able to get married and are rejected by family members. This disability associated with this disease renders patients unable to work, which impacts their families and communities.

The disease is often not life threatening and but causes permanent damage to the lymphatic system and kidneys. Lymphatic dysfunction and accumulation of lymphatic fluid occurs and causes swelling in the arms, breast, legs and genitals of men known as lymphedema. The swelling and decrease in the function of the lymphatic system compromises the body's ability to fight infections in infected individuals. Bacterial infections of the skin and lymph system occur with hardening and thickening of the skin called elephantiasis. Because the swellings asscociated with filarial pathology are often irreversible and associated with bacterial infections, careful daily washing of the swollen area with soap and water, use of anti-bacterial cream on wounds to stop the bacterial infections, limb elevation and exercising of the affected part of the body prevents swelling from getting worse and improves lymph flow.

Certain vascular endothelial growth factors (VEGF-C) are implicated in lymphatic dysfunction.. However, the pathology of lymphoedema and hydrocoele depends on many factors, which include lymphatic dilatation and accumulation of fluid in affected tissues (Debrah et al, 2007). Hydrocoeles of non-filarial origin may have other causes such as testicular tumor, scrotal trauma, epididymo-orchitis among others and are important in differential diagnosis (Noroes et al, 2010). The pathogenesis involves inflammation of the scrotal areas leading to the flow of peritoneal fluid into the scrotum (Noroes et al, 2010).

Beyond lymphedema, there is a broad array of symptomatology that directly or indirectly alters lymphatic structure and function. Although bancroftian filariasis results in damage to the lymphatic system most of those infected show few outward signs of infection and can only be diagnosed when tested. Very few people develop lymphedema due to accumulation of fluid and improper functioning of the lymph system with swelling of the affected part of the body. The parts of the body often affected by lymphedema are the legs, arms, breasts, and genital area. The resultant swelling and decreased functioning of the lymphatic system reduces the capacity of the body to fight bacterial infections especially in the skin and lymphatic system. There is thickening and hardening of the skin, a condition referred to as elephantiasis. The scrotal swelling that results in men is called the hydrocoele. Other clinical manifestations of bancroftian filariasis are pulmonary eosinophilia characterised by cough, shortness of breath and wheezing accompanied by increased levels of immunoglobulin E and antifilarial antibodies.

Filarial infection, from an immunologic point of view, is one of the most complex parasite infections. Moreover, these parasites have finely tuned immune subversion strategies that enable escape from the innate immune system. As different stages of the parasite interact with different types of antigen-presenting cells that, in turn, may play a significant role in shaping the subsequent adaptive immune response. (Semnani et al, 2004).

The usefulness of ultrasonography in the diagnosis of bancroftian filariasis has been demonstrated in the paediatric population. The technique has been able to show the change in location of the adult worms which occurs around puberty in males (Fox et al, 2005).

Diagnosis of bancroftian filariasis is a challenge. However, the gold standard for diagnosing the active infection is the identification of the microfilariae parasites in the blood smear taken at night due to the nocturnal periodicity of the parasite. The nocturnal periodicity requires that blood collection is done at night to coincide with the peak of the appearance of the microfilariae; Giemsa or haematoxylin and eosin staining of the thick smear is made on a slide for microscopic examination. Concentration techniques can be applied for increased sensitivity such a Nuclepore filtration, centrifugation or lysis of red cells to enhance visibility of parasites. Other serologic techniques for the detection of elevated levels of antifilarial IgG4 in the blood for the detection of the infection by bancroftian filariasis are available.

The polymerase chain reaction (PCR) is a useful and sensitive test for the diagnosis of LF. It also allows for differentiation of the species of the filarial parasite in human hosts, animal hosts and mosquito vectors in endemic areas (Nuchprayoon et al, 2005). Though the most widely used method for diagnosis of filariasis is microscopic examination of microfilariae from blood samples, the limited sensitivity associated with diagnosis of filaria by microscopy makes it unsuitable for large-scale microfilaria screening in LF endemic areas. It also requires considerable expertise to distinguish among filarial parasite species because of their rather similar morphological features. Identification of filarial infection using traditional morphologic methods can be difficult and lead to misdiagnosis(Itoh et al, 2007). It is relatively easy to monitor the reduction in prevalence and intensity of filarial infection. However, confirming this elimination is a more complicated and time-consuming process. The use of the ELISA test has been demonstrated to be a practical and useful for confirmation of the elimination of filariasis (Itoh et al, 2007).

Laboratory tools to monitor infection burden are important to evaluate progress and determine endpoints in programs to eliminate LF (Tisch et al, 2008). All infection indicators are expected to continue to decline five years after cessation of MDA; however, Bm14 antibody may persist in the greatest proportion of individuals. Data suggest that Bm14 antibody may be a sensitive test to monitor continuing transmission during and after MDA aimed at eliminating transmission of *W. bancrofti* (Tisch et al, 2008).

The duplex Doppler sonography is a non-invasive tool for visualizing adult *W. bancrofti* and for monitoring the effects of antiflarial treatment. Since therapy with DEC/Albendazole appears to be more effective at killing adult *W. bancrofti*, this treatment can be followed by de novo development of hydrocoeles supporting the fact that dying adult worms play an important role in the pathogenesis of filarial hydrocoeles (Hussein et al, 2004).

In China, a minimum of 10 years was required for the elimination to be achieved. Annual mass drug treatments with DEC (or ivermectin) and albendazole are being given in filariasis-endemic countries in the GPELF. Annual treatment needs to be repeated for at least five years. To determine if additional mass treatments are necessary, the filariasis elimination program in each country must have reliable information to compare with the pre control baseline data in sentinel sites, and trends in prevalence and intensity of the parasite to deterimine the impact of control on transmission. The ICT card antigen tests targeting children are a suitable way to obtain this information as they are the cohort of the population which should have been protected from acquisition of the parasites after the control programme began (Itoh et al, 2007).

Xeno-monitoring is a powerful tool for monitoring the impact of MDA on filariasis endemicity and transmission. The use of xeno-monitoring in the context of filariasis elimination programs also provides a powerful tool for assessing the impact of MDAs. The use of xeno-monitoring -based target that might be used with other targets such as microfilaria rate for filariasis elimination programs in areas where filariasis is transmitted by *Culex* mosquitoes (Farid et al, 2007). It needs to be noted that it is relatively easy to monitor the reduction in prevalence and intensity of filarial infection, however, confirming elimination is a more complicated and time-consuming process.

2.9 Treatment of Bancroftian Filariasis

The present treatment of choice for bancroftian filariasis is a combination of ivermectin (200µg/kg) and albendazole (400mg dose) given as a single dose annually is employed for the mass drug treatment of endemic populations in areas that are co-endemic for LF and onchocerciasis. DEC (6 mg/kg/day) in combination with albendazole (400mg dose) is administered annually in areas that are only endemic for LF and has no onchocerciasis. Caution is needed in treating with ivermectin and albendazole in areas where *L. loa* is endemic as ivermectin can cause severe adverse reactions in infected individuals with high *L.loa* parasitaemias (Ottesen et al, 1994; Bradley et al., 2001).

The Global Program to Eliminate Lymphatic Filariasis (GPELF) has been implemented to reduce human microfilaraemia to levels low enough to break the transmission of the disease by using single annual doses of albendazole in combination with DEC or ivermectin (Schwab et al, 2005). Available evidence does not support a difference in the efficacy of diethylycarbamazine alone as compared with DEC plus albendazole in the treatment of W. bancrofti, neither is there any statistically significant differences between the two drug regimens in decreasing the microfilaria positive rate at 12 and 24 months at a single dose treatment with either drug regimen (Bockarie et al, 2007).

Although the primary goal of the program is to interrupt transmission of *W.bancrofti* additional public health benefits also are expected because of the known anthelminthic properties of the drugs. Substantial reductions in intestinal helminth infections are associated with mass treatment of filariasis and are consistent with the conclusion that high levels of coverage for the LF program can decrease transmission of geohelminths (De Rochars et al, 2004). LF elimination programs provide important collateral benefits through the reduction of intestinal helminth burdens. To increase compliance as the LF program grows, health educational messages should place greater emphasis on other ancillary benefits of the program (De Rochars et al, 2004).

Combination treatment with ivermectin and albendazole could be expected to reduce the rate of selection for resistance to either of these anthelmintics provided that the resistance mechanisms involve different genes. However, it has recently been found that ivermectin selects on tubulin in the filarial nematode *O. volvulus* (Eng KLJ and Prichard RK, unpublished data). The implications of combination treatment on genetic selection need to be examined in future studies. Based on these findings, it is imperative to continue monitoring for the presence of this mutation, to detect early evidence of possible resistance selection and to correlate this with responses to treatment (Schwab et al, 2005; Osei-Atwenboana et al, 2007).

Standardised and reliable methods to evaluate the efficacy of anthelminthic drugs and recommended tests to monitor drug resistance in nematodes of veterinary importance in the field are available (Coles et al., 1992). Although there are as yet no convincing reports of drug resistance in human soil transmitted helminths, close monitoring of drug efficacy is needed to detect any possible treatment failure that may be due to increasing resistance or reduced efficacy (Osei-Atweneboana et al, 2007). Moreover, strategies need to be designed, including sustaining drug quality, in order to maintain the efficacy of the drugs presently available and so reduce the risk of developing resistance (Albonico, 2003).

The high prevalence of HIV and parasite infections in sub-Saharan Africa, results in large geographical overlaps and therefore the potential for interaction between these two types of infections in co-infected individuals. Helminthiasis may increase susceptibility to HIV and contribute to a more rapid progression toward AIDS. Treatment of helminth infections is thus likely to be particularly beneficial to HIV patients and has been found to be associated with a significant decrease in HIV plasma load. Apart from helminth infections, some protozoan infections interact with HIV. Thus, malaria has been shown to be an important factor in promoting the spread of HIV in sub-Saharan Africa (Nielsen et al, 2007). The findings suggested that DEC affected HIV load through its effect on the filarial infection rather than through a direct (pharmacodynamic) effect on HIV. Global efforts to control LF by annual mass treatment with DEC may have a beneficial effect on the HIV/AIDS epidemic in areas where HIV and LF co-exist (Nielsen et al, 2007).

Ivermectin and DEC are used in mass treatment programs for the elimination of LF because of their effects on microfilaremia. However, the effects of treatment on adult worms and the degree of individual variation in efficacy are unclear (Rajan, 2004). Elimination and reduced production of microfilaria from the blood by ivermectin is greater than with DEC, though some individuals respond poorly. The strong reduction in overall Mf production is good for control of LF, but the prospects of elimination will be diminished if part of the population systematically responds poorly to treatment (Stolk et al, 2005).

Important factors identified in the interruption of transmission due to *W. bancrofti* are a minimum of 6 rounds of MDA and good treatment coverage may help to interrupt transmission of the parasite. While high vector densities may partly nullify the reduction achieved in vector infection and infectivity rates by MDA; achievement of a microfilaria prevalence rates of 0% in communities and 0% infection rate in mosquitoes may be necessary to totally interrupt transmission particularly in *Culex* (Ramaiah et al, 2003).

Greater understanding of the pathogenesis of LF and methods to control this infectious disease has been made recently (Taylor et al. 2005; Taylor et al., 2010). Discovery that *W. bancrofti* contain endosymbiotic *Wolbachia* raises the possibility that endotoxin-like or other putative molecules produced by these organisms induce inflammatory reactions that contribute to lymphatic inflammation, bias filarial-specific immunity and regulate the reproductive potential of the parasite (Taylor, 2003; Debrah et al, 2006, 2007; Taylor et al. 2010).

Indeed, a key finding from our coupled economic and epidemiological analysis is that when initial uncertainty regarding eradication occurs and prospects for resolving this uncertainty over time exist, it is economically beneficial to adopt a flexible, sequential, eradication strategy based on controlling chronic disease initially (Michael et al, 2008).

Bancroftian filariasis is a major public health problem in Sub-Saharan Africa, where the level of transmission by the mosquito vector, human infection rates and clinical morbidity are among the highest in the world. Coordinated research, involving the disciplines of epidemiology, vector biology, immunology and genetics, has led to new insights into the ecology and pathogenesis of human LF. Recent work using this knowledge should be helpful in assessing local and global strategies aimed at eliminating *W.bancrofti* and in guiding research that will facilitate achievement of the elimination goal.

Chapter 3

Materials and Methods

Chapter 3: Materials and Methods

3.1 Description of Study Areas

3.1.2 Republic of Ghana

The Republic of Ghana is in the centre of the West Coast of Africa. The total land area is 238,537 sq. km and has 3 francophone countries sharing borders with Ghana. These are Togo on the east, Cote d'Ivoire to the west and Burkina Faso to the north and northwest. Ghana has a coastline which extends for about 560 km with the Gulf of Guinea or the Atlantic Ocean. The combination of low altitude and proximity to the equator gives Ghana a typical tropical climate. The rainfall figures are highest in the forested southwest and lowest in the north. The rainy season is different in the north and south of the country. In the north the rainy season falls within the months of May and September and in the south there are two rainy seasons, which fall within May and June and from September to October. The Harmattan winds blow from the northeast during the dry season bringing dust from the Sahara (Government of Ghana, 2006)

Ghana is typically divided into 3 ecological zones. These are the Coastal Savanna which is the sandy coastline backed by a coastal plain and also has several rivers and streams crossing it, the Forest zone which is found in the middle belt and western parts of the country which are heavily forested with many streams and rivers and finally the Northern savannah which is drained by the White and Black Volta rivers into the Volta lake. The Volta Lake has been artificially created for the generation of hydroelectric power is one of the largest artificial lakes in the world.

Figure 3.1: Map of Ghana (Government of Ghana, 2006)

The climate is typically tropical with temperatures and rainfall, which vary according to distance from the coast and elevation. The average temperature recorded annually is about 26°C. There are two rainy seasons. The minor one occurs from April to June and the minor one between September and November. The north has one rainy season, which begins in March/April and ends in September. The dry season or harmattan results from a dry desert wind which blows from the north-east between December and March, lowering humidity and creating warm days and cool nights in the north, however, in the south the effects of harmattan are most pronounced in January.

3.2 Demographic Profile of Ghana

With reference to the 2010 Population and Housing Census, Ghana's population is estimated to be about 24,658,823 in 2010. The population growth rate is estimated at 2.5 percent. This is made up of 48.8% males and 51.2% females. About 20% of the population is children under 5 years of age and 27.3% of the population are children between 5 and 15 years (school-aged). About 70% of the population live in rural areas and are mainly engaged in agriculture and fishing. Infant mortality rate is estimated at 65 per 1000 live births based on Demographic Health Survey data of 2008. The under 5 mortality is estimated at 100 per 1000 live births (DHS, 2003; DHS, 2008). There are many ethnic groups with diverse cultures and perceptions and also groups with religious beliefs and practices that may influence their attitudes and practices towards trachoma, LF, onchocerciasis, schistosomiasis and soil transmitted helminths infections (GHS, 2007).

Administratively Ghana is divided into 10 regions and 170 districts. Each region is headed by a political administrator (Regional Minister) under whom the Regional Director of Health Service works. There have been several re-demarcation of districts by recent governments resulting in the change in the number of districts from 110 to 138 and then to the present 170. The purpose has been to ensure the equitable distribution of resources for the efficient and effective administration at the local level under the local government system headed by the District Chief Executive and the District Assembly under whom the District Director of Health Service functions. All districts have been subdivided into an average of 7 sub-districts with each sub-district covering a defined geographic area of between 20,000-30,000 people. The proportion of Ghanaians living in urban areas has increased significantly since 1960, when only 23% of Ghanaians lived in urban areas. This proportion has since increased to 29% in 1970, 32% in 1984 and 44% in 2000 (GSS, 2000; GSS 2010).

Several ethnic groups form Ghana's human population. The largest grouping constituting 49% is made up the Akans (GHSS, 2000; GHSS 2010). Ghana was one of the strongest economies of Africa in the fifties, but political instability affected the economy, which declined rapidly. In recent times there is an increase in economic growth of 6 percent measured in GDP. Agriculture is the heart of the economy and cocoa remains the most important export commodity. Industrialization and mining are increasing as indicated in the Ghana Growth and Poverty Reduction Strategy II (IMF, 2012).

3.3 Economy

There has not been any significant change in Ghana's economy over the last 2 decades with Agriculture being the most important area of economic activity, followed by services and then industry. Agriculture contributes 34% of the Gross Domestic Product (GDP), (GSS, 2008) and employs about 50% of the population (GSS, 2002). This sector is the fastest growing at 10% and contributes a third of the country's GDP. Ghana's leading export commodities are cocoa, gold and timber. Among the reforms introduced into the educational system in the last decade in Ghana are the introduction of pre-school education into the government basic school system, countrywide introduction and implementation of the Capitation Grant which is offering free education to pupils in government basic schools, the free School Feeding Programme aims at improving the nutritional status of children and has also increased school enrolment. The Getfund (Ghana Education Trust Fund) has also provided educational infrastructure to improve teaching and learning (IMF, 2012).

3.4 Health Structure

The Ministry of Health (MOH) has the overall responsibility for the total health services of the country; and is responsible for the overall sector-wide policy formulation, monitoring and evaluation of progress in achieving targets. The MOH prepares an Annual Programme of Work, which is funded with collective resources from Government of Ghana (GOG), internally generated and donor funds.

The Ghana Health Service (GHS) is the implementing agency of the Ministry of Health responsible for health service delivery. Health management in Ghana is decentralized within the GHS. It involves District Health Management Teams (DHMTs), Regional Health Management Teams (RHMTs) and Headquarters. Complementing this arrangement are institutional/ health facility management teams. Each of these management levels is a budget and management centre (BMC) responsible for a defined programme of work supported by a definite operational budget.

Health services in Ghana are delivered at three levels: Primary, secondary and tertiary levels. At the Primary level the Primary Health Care (PHC) is delivered by the District Health System. It comprises all institutions (clinics, health centres and hospitals) and individuals whether private, public or traditional. The health centre is responsible for providing clinical, public health and maternity services to the catchments population using a combination of facility-based, regular outreach and mass campaigns in close collaboration with communities, community institutions and leaders and village based health workers and health institutions. The district hospital serves as the first referral point in the primary health care service. They provide clinical (out-patient and in-patient) and maternity services, and serves as a backup for health centres in the district. At the secondary level the regional hospital is the second referral level offering specialized services. The teaching hospitals form the apex of specialized care in the country and are labelled tertiary centres. Expenditure on health in 2006 was about 14% of total government budget (Ghana Health Service, 2011, Unpublished).

3.5 The Primary Health Care System

Health care delivery in Ghana is based on the PHC. However, not all parts of the country are adequately covered. Water supply and sanitation, which are components of the PHC, are particularly inadequate in many parts of the country. In almost all the regions there are areas, which are inaccessible at certain times of the year. NGOs, Missions, Private and Development Partners play leading roles in providing health care in some of the areas that are not adequately covered by the formal system. In addition, some of them also supply drugs, vaccines, equipment and provide water and sanitation facilities. It is noteworthy that they have helped in Expanded Programme of Immunization (EPI), Guinea Worm Eradication, Onchocerciasis Control, elimination of LF, control of Trachoma, Soil Transmitted Helminths and other child survival programmes. These health intervention programmes have been successfully integrated into the PHC in Ghana. Community Health Planning Services (CHPS), is a new concept developed to bridge the gap of health delivery between accessible and inaccessible areas (Five Year Strategic Framework for Service Delivery, 2007-2011, Ghana Health Service, 2008).

3.6 The Five Start-Up Districts for Lymphatic Filariasis Elimination

3.6.1 Ahanta West District

Ahanta West District is located at the southern most point of the country and the entire West African Sub-Region with its capital Agona Nkwanta also called Agona Ahanta. The Ahanta West District has a total land area of 591 square kilometers. The population of Ahanta West from Ghana 2010 Population and Housing Census IS 106,215 which is made up of 6568(52%) females and 60635 (48%) males with as average household size of 6. The district is made up of 19 towns. The major economic activity in the district is agriculture, employing about 59% of the population. Most of the people are small-scale farmers. Coconut, oil palm and rubber are the main cash crops. Generally, the soils in the district are very fertile and their types range from loose sand to clay. The proximity to the central business district of Takoradi enhances business and trade in particular. Investment in cold storage has strong profit potentials. So far, mining has not had a significant input on the district even though available records show that the district is endowed with gold, diamond, manganese and clay. Some of the social facilities available in the district include roads, electricity, transport and telecommunication. The Ahanta West district, which once used to be covered largely with primary vegetation, is now covered mostly with secondary forest. The adverse effects of human activities on the environment include poor sanitation and health related problems. The District has a District Health Committee which is an advisory board and the District Health Management Team (DHMT). The DHMT plans, monitors, supervises to ensure that all health activities planned are implemented. The district has been divided into four sub-districts for the purpose of implementation of Health activities.

3.6.2 Kassena Nankana District

Kassena Nankana East District, one of the nine districts in the Upper East Region is located in the northern part of Ghana. The Republic of Burkina Faso, and the Bolgatanga, Bongo, Builsa, Sissala and Mamprusi West Districts border it. It stretches for 55 kilometres from north to south and 53 kilometres from east to west. The district capital is Navrongo. The Kassena-Nankana District of the Upper East Region lies within the Guinea Savannah woodland of Ghana. In 2003 it was divided into 2 districts, Kassena Nankana East and Kassena Nankana West districts. For the purposes of this write up it is considered as one district. The Sissala District in the west, Bongo and Bolga districts in the east and northeast, Kassena Nankana West in the north and Northern region in the south, border it. There are two main climatic seasons. A short rainy season, which lasts from June to September, during which, many remote communities are inacessible due to flooding. The dry season lasts from October to May, with the harmattan winds peaking in January and February. The temperature ranges from 20°C to 40°C. The population of the District is mostly rural, apart from those living in Central Navrongo. Settlements in Kassena-Nankana, are dispersed with closely-knit extended families living in the same compounds. The average number of residents per compound is ten. The compounds are made up of several small-connected huts surrounded by the compound's farming land. With the dispersed settlement pattern and no compact villages, health service delivery is often difficult. The District is divided into six sub districts - Central, North, South, East, West and North East. The District Hospital is the referral point for these sub-districts. The estimated population of the District from the 2010 population and housing census is 180,611 made up of Kassena Nankana

East (109,944) and Kassena Nankana West (70,667) living in some 108 communities. It has a land area of 1,658 square kilometres and a population density of 97 people per km2. About 90% of the District is rural – only 10% of the population lives in the Navrongo Township (Government of Ghana,2006).

3.6.3 Awutu Efutu Senya District

Awutu-Efutu-Senya district another of the 5 start up districts of the LF elimination programme has recently also been divided into 2 districts namely Efutu Municipal and Awutu-Senya districts with a total population of 263,903 according to the 2010 Population and Housing Census. Awutu-Senya district with its capital Awutu Breku forms part of the new districts while Efutu Municipal, which before 1988 was part of then Gomoa-Awutu-Effutu Senya District Council.
The Effutu Municipal is situated on the eastern part of the Central Region of Ghana. It is sandwiched by Greater Accra Region and Ga Rural, Agona and Gomoa. Agona Municipal, borders it to the north in the north-east by the West Akim Municipal, to the south by the Gulf of Guinea, to the east Gomoa District and Ga West Municipal, and on the west by the Gomoa District. Effutu Municipal covers an area of 417.3 square kilometers (163 sq miles) and has 168 settlements (Government of Ghana, 2006).

3.6.4 Sissala District

Sissala district, one of the 5 start up districts of the LF programme, is now divided into Sissala East and West districts. Sissala East District is located in the northwestern part of Ghana in the Upper West Region. The district capital is Tumu. To the east, it shares boundaries with Kassena Nankana and Builsa district, both of the Upper East Region while its extreme southeastern portion shares a boundary with West Mamprusi District of the Northern Region. Its neighbours in the Upper West Region are Wa and Nadowli districts to the south and Jirapa district to the west. The Sissala East District is located in the north-western part of Ghana in the Upper West Region. The total land area is 7,115 sq. km, which is about 39% of the landmass of the whole Upper West Region. The sheanut tree is significant economic asset to the district whose population is currently estimated at 56,528 (2010) with an annual growth rate of 1.7% and a population density of 12 persons per sq km, which is lower than the regional and national averages of 24 and 77 respectively. Patches of high population density are found in the relatively urban settlement such as Tumu, Wellembelle, Sakai, Nabugubelle, Nabulo and Bujan (Government of Ghana, 2006) Sissala West district is located in the North Eastern part of Ghana. It shares Boundaries with the Jirapa Lambussie District to the West, Sissala East District to the East and Burkina Faso to the North and Wa East District to the South. The district sharing a border with Burkina Faso facilitates cross border socio-economic activities. However, this has its own implications for health and social stability.

3.6.5 Builsa District

The Builsa district is one of the nine (9) districts of the Upper East Region of Ghana. It is bounded on the North and East by the Kassena-Nankana District; in the west by the Sissala District and in the South by the West Mamprusi District and part of Kassena-Nankana District. With a total land area of 2,220 square kilometres, the district accounts for over a quarter of the total land area of the Upper East Region thereby making it the largest district in the Region. The district capital is Sandema (Government of Ghana, 2006). A significant portion of the district falls within the Volta Basin and is dissected by the White Volta and its tributaries, namely the Sissili, Kulpawn, Belipieni, Bukpegi and Asebelika. Most of these watercourses, however, are seasonal and dry up during the extended dry season. The vegetation is characterized by savanna woodland and of deciduous, widely spaced fire and drought resistant trees of varying sizes and density with dispersed cover of perennial grasses and associated herbs. Over time, the savannah has been reduced to open park land with trees of economic value like baobab, acacia, sheanut and dawadawa dominating. Temperatures are high and the dry season is characterized by dry harmattan winds and wide diurnal temperature ranges. There is only one rainy season, which builds up gradually from little rains in April to a peak in August / September declining sharply and coming to a complete halt in mid-October when the dry season sets in. Greater part of the soil comprises of ground water laterite developed over the granitic formations. Soil textures vary within the district but coarse textured soils predominate with various amounts of loosely packed stones and concretions. The alluvial soils of the south are very suitable for rice production due to the seasonal flooding in the areas (www.ghanadistrict.com).

In these five start-up districts health professionals at various levels in these districts provide wide range of services in nutrition and child health. They also face similar challenges in health delivery. These include growth monitoring, micronutrient supplementation (Vitamin A supplementation and Iodated salt monitoring), immunisation, exclusive breast-feeding, nutrition education and the early introduction of appropriate complementary foods for young children. The above sums up to further facilitate the process of healthy growth and development of the citizens of the Sissala East District. Apart from the above the DHA has special program areas, which include HIV/AIDS, Tuberculosis, Malaria, Guinea Worm, Trachoma and LF (Ghana Health Service, District Annual Reports, 2005-2008).

The major health care delivery problems in the districts include high maternal and child mortality rate. Other health challenges faced in these districts include inadequate health staff and logistics, high levels of malnutrition among children under five years, low health service utilization at facility level, inadequate staff accommodation among district health workers, inadequate in-service training for health staff and inadequate funding for programs such as the NTD Programme (District Annual Reports, 2005-2008).

3.7 Methods

3.7.1: Study Design

This study reviewed retrospective longitudinal data collected since the inception of the Ghana Filariasis Elimination Programme (GFEP) in 2000 to 2005 and prospective cross-sectional data collection collected from 2006 to 2010. The study built on available baseline and follow up programme data. A sample of 5 districts from the two main LF transmission zones in Ghana was selected for the assessments. These 5 districts have completed the minimum of 6 annual rounds of programme implementation. Data from the health system at various levels were also reviewed for assessing the health system. This included reports of coverage, prevalence study data and monitoring and evaluation data collected from the district, regional and national levels of the programme for LF and other preventive chemotherapy diseases being implemented together with the LF Elimination Programme. Available reports and interviews with health workers and the community members were employed to determine the impact of the programme to eliminate LF on the health system, Onchocerciasis Control, Schistosomiasis and Soil Transmitted Helminths Control as other public health programmes being presently implemented in an integrated approach with the LF Elimination Programme

3.7.2: Cross-sectional Study

The goal of the prospective cross-sectional studies was to evaluate the LF elimination programme after 6 years of programme implementation. This study looked at compliance with the annual mass drug treatment programme with ivermectin and Albendazole, and also included a knowledge, attitude and practice study in the 5 districts that have completed 6 rounds of mass drug treatment and 4 other districts that are implementing the integrated NTD Control Programme. Compliance was determined, as the number of times individuals surveyed had participated in the annual MDA by swallowing the drugs administered under direct observation. Coverage on the other hand, determined the participation of an individual in an annual MDA for any particular year under direct observation.

The sample frame for this study was the population within the start-up districts of the LF elimination programme. Each district was considered as a single unit, from which 30 clusters or communities were randomly selected for the assessment.

3.7.3: Longitudinal Study

Retrospective Longitudinal Data was employed by assembling and organizing routine programme data from annual reports. Programme monitoring data was also gathered and organized from sentinel surveys. These data included microfilaria prevalence and density data and filarial antigen prevalence data. These data have been collected using the WHO recommended methods, sometimes modified to suit the programme situation. For the first 2 years of programme implementation, a coverage survey was conducted using the 30 cluster sampling method for each of the 5 start-up districts. These surveys were conducted in 2001 and 2002. Subsequent surveys selected 30 clusters from all the endemic areas combined. However, a total population census was conducted for these subsequent assessments. Therefore 6 communities were selected from each of the 5 endemic regions and 3 communities selected per district. A total of approximately 20,000 people were involved annually in the coverage surveys from 2003 to 2005.

From 2006 with the inception of the integrated NTD Control Programme to the present, integrated surveys involving LF and other preventive chemotherapy and transmission control diseases, which have undertaken MDA, have been undertaken in selected districts. The results of these integrated cross-sectional surveys have been compiled, analysed and reviewed as part of this thesis.

The method for the longitudinal impact assessment for microfilaria prevalence and density and filarial antigen prevalence were also based WHO guidelines. For the first two years of programme implementation two sentinel and one cross-check sites were selected for each implementing districts according to the WHO. For each of these sites 100 people were randomly sampled for the assessment involving the collection of night blood samples and preparation of the slides for examination under the microscope for microfilaria. Parasite prevalence and community parasite densities were then determined to follow up on the impact of the MDA. As the programme gradually up-scaled this had to be changed to two sites per a maximum population of 1,000,000 due to resource constraints. Baseline blood surveys were done before the first mass drug distribution, followed by another survey after the third distribution at mid-term and then another after the fifth distribution after end of term.

3.7.4: Sample Size Calculation

The prospective cross-sectional study involved a coverage survey. Non-compliance with treatment and Knowledge, Attitude and Practice (KAP) were also assessed. This part of the study focused on the 5 start-up districts. A 30-cluster sampling method was applied in determining the sample size for the 5 districts. Estimated population sizes of 40 individuals from 8 households were interviewed within each of the 30 clusters. An estimated total minimum sample size of 6,000 individuals was interviewed in the study in Ghana.

The sample size was calculated (http://surveysystem.com/sscalc.htm, 2007 accessed 10 December 2011) using the formula below:

$$SS = \frac{Z2 * (P) * (1-P)}{C2}$$

This sample size formula gave the minimum number of households to interview per district.

'P' is the prevalence of the variable of interest which is the coverage in this case. The target coverage is 80%, however the minimum coverage required is 65% of the total population of the district.

'C' is the allowable error with which the estimate of the prevalence that will be accepted. If the 'P' is the 60% if then 'C' could be 5% or even 10%.

'Z' is the value for 95% confidence level (1.96)

The sample size 'SS' is the minimum number of households to be selected per district. The average number of persons per household is usually 5 in Ghana and so for the 30-cluster sampling method if 8 households are to be visited in each the 30 selected communities, then 5*8*30=1200 individuals had to be interviewed for the coverage survey. This made available a total of 6000 (1200*5) for the 5 districts.

3.7.5: Study Tools

Questionnaires (appendix I and II) were designed for the compliance and the KAP study. Individual interviews with household heads or their representatives who could be a spouse, child were conducted for each selected household. The questionnaires had both open-ended and closed-ended questions and a table for all the household members. The designed questionnaires were pre-tested before the actual fieldwork both at the national level and in the field before data collection.

For the blood surveys, an estimated number of 4,500 people were surveyed. Two sentinel and one cross-sectional site were surveyed for each district for microfilaraemia. The microfilaria prevalence, count and densities were determined for each community surveyed.

For the adults, a night blood test was carried out. After the site for the finger prick has been cleaned, a lancet was used to carry out the finger prick and 2 drops each of 50 microlitres was taken using a micropipette and each dropped on a clean slide. A thick and a thin film of the blood were prepared. The slide was then dried and processed by dehaemoglobinisation using methylated spirit, and then stained using Giemsa for microscopic reading in the laboratory. The parasite count was then done and the microfilaria parasite prevalence and densities determined.

To determine the end point of MDA, sentinel communities with microfilaria prevalence rates of less than 1% among the adult population are to be selected from available sentinel data. Antigen tests were then to be conducted on 300 children aged from 2-4 years using the ICT card tests. If no child was found to be positive for the antigen test, 5 communities in which no knowledge of microfilaria and antigen prevalence rates are known are to be selected and also submitted to a similar process to determine the possibility of halting MDA in these selected districts (WHO, 2001b). For the test a finger prick will be done using a lancet after the site has been cleaned with methylated spirit and then about 100 microlitres of blood was taken using a micropipette. This blood will be dropped on an Immunochromatographic Test (ICT) card and the results of the antigen test read immediately after 10 minutes, according to the manufacturer's instructions.

Due to the unavailability of the ICT card tests and the need to possibly develop other possible tests for use by programmes to determine the end point of MDA, the Og4C3 antigen and Bm14 antibody ELISA tests using filter paper spot blood was employed for this study. This child survey was conducted concurrently with the adult surveys. While the samples for children were collected during the day within the communities, those for the adults were collected at night.

Filter paper was cut into 1cm squares and labeled. Blood spots obtained from the children of about 60µl was dropped on the filter paper, which was air-dried, placed in zip lock rubber and frozen in a cold room at temperatures less than $0^{o}C$. The antigen (Og4C3) and antibody (Bm14) kits were procured and applied for determining positive and negative antigen and antibody tests results. Both antigen (Og4C3) and antibody (Bm14) tests were conducted on each sample (Appendix III).

To measure the impact of morbidity management two surveys were conducted. One assessed the impact of morbidity management on patients with hydrocoeles or lymphoedema, while the other evaluated the hydrocoele surgery programme in one region. Assessment of the lymphoedema management and hydrocoele surgery programme involved the same communities selected for the MDA coverage assessments. In these communities, cases of hydrocoeles and elephantiasis were identified and prepared questionnaires administered. These questionnaires focused on their knowledge, attitude and practice to LF morbidity. Awareness of the lymphoedema management manual, free hydrocoele surgery programme and the impact of morbidity control activities on their condition and general health assessed by questionnaire.

Patients with hydrocoeles were also selected from the same communities using the community registers. They were categorized into those who have had the drug treatment and surgery and those who have only had the drug treatment. Those who had the surgery were interviewed as a way of assessing the success of the surgery and proportion of men who have benefited from the surgeries determined as a measure of the success or otherwise of the hydrocoele surgery programme. Quality of life assessment was also carried out for the cases that had benefitted from the free hydrocoele surgery programmes.

The impact of the programme on the health system was assessed at all 4 levels: the national, regional, district and community. This was done by reviewing programme information available from all these levels of the health system. The impact of the LF elimination programme on other public health programmes was assessed using the Schistosomiasis, Soil Transmitted Helminthiasis and Onchocerciasis Control Programmes. These assessments were undertaken by examining programme management, funding, and delivery of the programme in terms of timing of interventions and monitoring and evaluation.

Clearance to undertake the community surveys was dependant on the community leaders and opinion leaders who were contacted and their permission sought before the community blood surveys were conducted. Consent of parents was also sought for all children who were involved in the blood surveys. Informed consent forms were designed and applied for the study wherever applicable.

Outcome Indicators

1. Microfilaria prevalence
2. Microfilaria density
3. Microfilaria antigen prevalence
4. Quality of life indicators for hydrocoelectomy beneficiaries
5. Identify areas for integration that are being implemented and other potential areas for integration
6. Achievements and challenges of integration

Expected Outcome

1. Reduction in microfilaria prevalence
2. Reduction in microfilaria density
3. Reduction in antigen prevalence
4. Reduction in size of the limbs of patients with lymphoedema
5. Improved quality of life among beneficiaries of hydrocoelectomies

3.8 Handling and Managing of Data

For all the field surveys data collection tools were developed as part of the proposal development. In the case of the questionnaire these tools developed were pretested in the field in communities that had not been selected for the surveys. The pretesting was used as a dual activity to pre-test the questions while it was also used as an assessment of the field workers. Poor performing field workers were excluded at this stage while the fieldwork was shared among the remaining workers who had acquired adequate skills with the training provided to undertake the field activities. The completeness and accuracy of the field data was checked by the research student with the help of technical officers on the programme and all corrections made before the data was entered in epi info 6. With the support of a data manager then the completed tools, counts, documents with the figures were submitted. The name of the project, date and signature was appended to this summary sheet. Data entry screen was done in duplicate and double entry done for the data. Problems encountered during data entry, analysis and report writing were dealt with by the research student with the support of a data manager

Tools for the blood surveys are also developed as part of the proposal development stage and directly applied during the fieldwork. Ethical approval was obtained from both Liverpool School of Tropical Medicine and the Ethical Review Committee of the Ghana Health Service and Ministry of Health for this study.

Chapter 4

Monitoring Coverage of Mass Drug Administration

Chapter 4: Longitudinal Monitoring of Mass Drug Administration

4.1 Introduction

Annual treatment of entire at-risk populations diagnosed to be endemic for LF is the mainstay of control and possible elimination of the disease (Ottesen et al, 1997; 1999; 2008; WHO, 2010; WHO, 2012). This requires achieving and sustaining adequate coverage with MDA for periods long enough to ensure interruption of transmission within endemic population. For LF elimination, this has been estimated to require a minimum of 5-6 rounds of annual MDA for entire at-risk populations in order to achieve interruption of transmission (Ottesen et al, 1997; 1999; 2008; WHO, 2010; WHO, 2012). The GAELF therefore recommends 5 rounds of effective MDAs to bring the community microfilarie load to less than 1% and 1/1000 in children born since the initiation of MDA with evidence of infection (WHO, 2006; WHO, 2011). Ghana's country programme like other endemic countries faced the challenge of achieving this objective in the face of other responsibilities in health since this requires high geographic (100%) and therapeutic treatment coverage (80%) of implementation units for elimination to be possible (WHO, 2005).

The concept of community-directed treatment was developed as a simple, effective and sustainable strategy implemented within the context of the socio-economic constraints of the health system. This strategy depends on the endemic community's ability to mobilise, train and treat the community members with ivermectin for onchocerciasis following the standard procedures and guidelines provided by African Programme for Onchocerciasis Control (APOC) (WHO, 1996). For LF elimination the strategy is to provide a single dose of the 2-drug regimen albendazole and ivermectin (in countries endemic for onchocerciasis) once a year for all eligible persons within the at-risk communities for LF (Ottesen et al, 1997, Ottesen, 2000). To complement the community-directed treatment strategy, knowledge of the geographic distribution of the disease, effective drug treatment, an effective delivery system, political commitment by the national governments and international and local community of partners are essential (Gyapong et al, 2005).

Several factors affect the transmission of LF and, therefore, the possibility of elimination. This effort is directed at diagnosis, treatment and prevention of the infection in whole at-risk populations instead of individuals using the double drug regimen of albendazole and ivermectin in Ghana. The goal of the Ghana Filariasis Elimination Programme is to interrupt transmission of *W.bancrofti* by targeting identified endemic communities and instituting MDA aimed at reducing community parasite load to such low levels that transmission can no longer be sustained (Ghana Filariasis Elimination Programme, 1999) and the infection would die out naturally. It has been estimated this will require 5-6 rounds of annual MDA with ivermectin and albendazole. About 80% of the total endemic population that represents 100% of the population eligible for treatment is the target (WHO, 2000).

The safety of ivermectin and albendazole has been shown to be widely acceptable (Gyapong et al, 2003; Mohammed et al, 2008; Simonsen et al, 2010). Ivermectin is effective and well tolerated for decreasing microfilaria in LF. The side effects experienced with ingestion of ivermectin is related to inflammatory reactions to dead parasites especially the microfilariae while the intensity of side effects is proportional to the individuals pre-treatment worm load (Brown et al, 2000). It is, however, not recommended for use in pregnancy (Pacue et al, 1990). Albendazole is also, safe with few side effects that may be related to the drug itself (Bradley et al, 2001). Albendazole is able to reduce *W. bancrofti* microfilaraemia progressively over a period of 6-12 months (Gyapong et al, 2005). Ghana Programme employs the single dose, two-drug treatment regimen of ivermectin and albendazole once in a year to interrupt transmission. Used together their safety profile remains the same (Awadzi et al, 2003) while albendazole improved the outcome of ivermectin in decreasing mf density or enhance the clearance of mf. Indeed at high doses albendazole has high macrofilaricidal activity (Ottesen, 2006; Jayakody et al, 1993).

Dose-poles are employed to determine the dosage of the ivermectin required for treating all eligible individuals. Exclusion of pregnant women is done using the history of the last menses of post-pubertal females and can be unreliable although the evidence obtained from inadvertent treatment does not give rise to concern (Bradley et al, 2001; Gyapong et al, 2003). Other categories of individuals excluded from treatment during MDAs include the seriously sick, children less than 90cm which is estimated to correspond to the age of 5 years, and lactating mothers of children less than a week old (WHO, 1996).

The community-directed treatment approach has been found to be the most effective method of drug distribution in Ghana and compliance is ensured by applying the directly observed treatment strategy (DOTS) (Gyapong et al, 2001). The process requires effective social mobilisation strategies that involve health education using the mass media, IEC materials and community meetings. Sometimes social marketing strategies are also employed (Ghana Health Serice, 2004, Unpublished). These strategies inform and sustain the interest of the communities in the distribution programme in Ghana.

4.2 Mass Drug Administration in Ghana (Community Directed Treatment for Lymphatic Filariasis in Ghana)

The strategy of MDA has been the bedrock of the GPELF (WHO, 1996), within the African sub-region and also in Ghana. This strategy is based on the fact that there is a large reservoir of individuals in endemic populations who harbour the filarial worms and yet show no outward signs of the infection (Simonsen, 2008). In order to ensure elimination of transmission, therefore, there is the need to ensure annual treatment of all these individuals over a minimum of 6 years (Simonsen, 2008). This is because mass treatment has been adequately demonstrated to have an impact on reducing the transmission of LF. The community-directed treatment approach has been demonstrated to be the best approach for achieving adequate coverage rates with the MDA programme. The process is greatly enhanced by the involvement and mobilisation of women, youth and minority groups in the communities (Gyapong et al, 2001; Brieger et al, 2002).

Earlier research carried out by various groups particularly in Africa have established the community directed treatment approach was an effective method of achieving the target programme coverage of 80% of the total population or 100% of the eligible population in all identified endemic areas of a country (Gyapong et al, 2001; Amazigo et al, 1998). This strategy of community directed treatment was first designed and implemented by the Onchocerciasis Control Programme of the WHO after discovery of ivermectin for the treatment of onchocerciasis in endemic communities (Amazigo et al, 1998). This was referred to as the community-directed treatment with ivermectin (CDTI). This strategy ensures sustainability of national onchocerciasis control programmes through improved ownership with significant cost-savings (Amazigo et al. 1998). This strategy has also provided the impetus for development of the primary health care in remote and difficult to reach rural communities (Hopkins, 1998) and is being applied for the control of the other NTDs, particularly those requiring MDA

4.3 Compliance

Compliance with ivermectin and albendazole treatment is key to the achievement of elimination of LF. Factors important in ensuring compliance include socio-demographic characteristics, perception of personal susceptibility, knowledge about the cause/transmission of the disease, knowledge about the signs and symptoms of onchocerciasis, available treatment, benefits and dangers of taking ivermectin, organisation of distribution of ivermectin, work and selections of community-directed drug distributors (CDDs), social influence and support to take ivermectin and on barriers and supports towards compliance with ivermectin treatment (Nuwaha F et al, 2005). Others include perceiving CDDs as doing their work well, believing that measuring height is the best way to determine one dose of ivermectin, having social support from one's family saying that ivermectin prevents onchocerciasis and in this case LF and perceiving radios as supporting treatment with ivermectin (Nuwaha F et al, 2005). The role of health education in ensuring compliance is significant. This influences the risk perception of communities, rationale for using dose poles for determining dosage, benefits of ivermectin as an effective drug against LF and/or onchocerciasis and knowledge about possible side effects such as itching, dizziness, headache, nausea and swollen limbs which disappear on their own after a while (Nuwaha F et al, 2005,).

The role of CDDs in ensuring compliance during the community-directed treatment process involved the availability of CDDs from within the community for the training, drug distribution and reporting (WHO, 1996). They should be trusted and respected members of the communities and should play a role in health education (WHO, 1992). Continuous motivation and support to do their

work contributes to the improved performance of CDDs in their work (Amazigo et al, 2002; Katabarwa et al, 2005;; Brieger et al, 2011).
Ghana is endemic for most of the diseases designated as the NTDs and has been running disease specific control programmes covering the Trachoma, LF, Onchocerciasis, Schistosomiasis and Soil-transmitted Helminthiasis which overlap geographically (Ghana Health Service, 2007, Unpublished). Furthermore, some of these programmes use the same drugs for treatment and use similar strategies of drug delivery. In view of the existence of these common factors, there was the need to integrate these related activities in order to maximize available resources and rationalize the operation of the various programmes, which employ various drug packages for mass treatment. These drug packages include ivermectin and albendazole, ivermectin only, albendazole/mebendazole only, praziquantel only, praziquantel and albendazole/mebendazole and azithromycin. Ghana runs the integrated programme and employs different drug packages determined by disease endemicity and overlap. Implementation of programmes to control or eliminate diseases like LF, onchocerciasis, trachoma, schistosomiasis and soil-transmitted helminths, through annual MDA, has been in place for many years now. There has been increasing emphasis on the integration of some activities of these vertical disease control programmes aimed at improving programme efficiency and saving economic and human resources. Integrated assessment of coverage started in 2007 and is presented as part of the longitudinal assessment of programme data.

Surveys to determine the impacts of the programme have been achieved through longitudinal monitoring of reported coverage or regular coverage surveys and a cross-sectional coverage survey carried out as part of this PhD study. Some of these surveys had Knowledge, Attitude and Practice (KAP) components for both LF only and NTDs including LF for the integrated NTD/PCT programme have been carried out. An NTD KAP survey was conducted to aid the development of IEC materials and an advocacy and communication strategy has also been undertaken. All coverage indicated in the write-up is total population coverage and not eligible coverage. The total population coverage is defined as the number of individual treatments in a given geographic areas with the denominator being the total at-risk population expressed as a percentage (WHO, 2005).

4.4 Presentation of Survey Results

Since the inception of the LF elimination programme assessments of treatment coverage through surveys have been undertaken to enable determination of the reliability of reported MDA coverage. These have been undertaken annually within 3-6 months of implementing MDAs. The methods for undertaking these surveys have not been uniform though information generated has been applied for informing programmatic decision making. Initial surveys undertaken were LF disease specific but since the implementation of the integrated NTD programme integrated surveys involving other preventive chemotherapy diseases being implemented have been carried out. Surveys undertaken (Table 4.1) include surveys to determine treatment compliance with ivermectin and albendazole over several years. The surveys have been quantitative, cross-sectional and exploratory focusing on the MDAs using ivermectin and albendazole and programme implementation for the first 5 rounds of programme implementation.

Since year 6 integrated surveys, which involve assessments for LF and other preventive chemotherapy diseases, have been conducted (Table 4.1). In year 1 and 2 the LF programme had just been initiated and the surveys apart from being conducted to assess the reported coverage also had the objective of describing the programme development or the scaling up process of the community-directed treatment (COMDT) method (Gyapong et al, 2001). This method had been adopted as the strategy for ensuring adequate coverage with the MDAs and exploring other practical methods for sustaining mass treatment of LF to facilitate the global elimination of this public health problem (Gyapong et al, 2000; Amazigo et al, 1998). All other subsequent surveys, though they had similar objectives, varied in the depth and conduct.

KAP surveys and also morbidity assessment surveys have also been undertaken to inform the programme's advocacy and health education strategies. These data have been assimilated as longitudinal data for analysis and discussion (Table 4.1).

4.5 Results of Surveys

4.5.1 Year One (2001) Coverage Survey

Assessment of year 1 treatment was undertaken in all the start-up districts, namely Ahanta West, Kassena Nankana, Awutu Efutu Senya, Sissala and Builsa districts. For year one the reported coverage ranged from 71.0% in Awutu Efutu Senya district to 87.4% in Sissala district. Surveyed coverage ranged from 71.4% in Kassena Nankana to 85.8% in Sissala district. The differences in coverage for the surveyed and reported coverage for each of the districts were between 1.6% to 12.6%. The differences were less than 10% for 3 districts and more than 10% for 2 districts. The coverage reported for 3 out of 5 districts were therefore reliable (Table 4.2).

4.5.2 Year Two (2002) Coverage Survey

In year two coverage surveys were repeated for the 5 start up districts. Reported coverage ranged from 75.7% in Sissala district to 88.5% in Ahanta West district. Surveyed coverage ranged from 75.7% in Kassena district to

88.5% in Sissala district. The difference in coverage ranged from 2.5% to 12.7% with two districts having coverage of above 10% (table 4.3).

4.5.3 Year Three Coverage Survey Results

In year three MDA was conducted for 30 implementing districts having scaled up from 14 districts. A total at risk population of 3,696,893 was targeted with about 9,100,000 tablets of ivermectin and 3,522,000 of albendazole. About 2,622,722 individuals were treated with total population coverage of 70.9% for year 3 MDA. Year 3 MDA was followed by a coverage survey to validate the reported coverage. The 30-cluster-sampling method was applied but all 30 implementing districts were considered as one unit from which the 30 community clusters were selected. Instead of further sampling in these communities the entire community populations were surveyed. All individuals living and present in the community at the time of the survey were sampled for these surveys. These 30 communities were selected from 10 sub-districts in 9 districts (Table4.1, 4.4 and 4.5), which included 4 of the 5 start-up districts. Two of these sub-districts were selected from one district.

A total of 10,721 individual from 2116 households were sampled. The total number treated was 7870 with total population surveyed coverage of 73.4%. The reported total population coverage was 70.9% giving a difference of 2.5%, which was within the acceptable limits of up to 10%. For each of the 9 districts surveyed the surveyed coverage ranged from 64.2% in Awutu Efutu Senya district to 83.8% in Nanumba district. Reported coverage ranged from 67.0% in Mpohor Wassa East district to 88.8% in Ajumako Enyan Essiam. The difference between the reported and surveyed coverage by district also ranged from 0.0% in Nanumba where both reported and surveyed coverage were the same to 23.0% in Ajumako Enyan Essiam district, which had the highest reported total population coverage.

Table 4.1: Longitudinal Coverage Surveys and KAP Surveys

No	Survey	Year	Disease Treatment Assessed	Method	Study Areas (District)	Sampling
1	Upscaling of ComDTI	2001	LF	Cross-sectional quantitative and qualitative	Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa, KND (5)	30-cluster random sampling per district
2	Upscaling of ComDT II	2002	LF	Cross-sectional quantitative and qualitative	Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa, KND (5)	30-cluster random sampling per district
3	Coverage Census	2003	LF	Cross-sectional quantitative and qualitative	Countrywide (9) AEE, AES MWE, AW, Builsa, Builsa, Nadowli, Sissala, *Nanumba, Zabzugu	30-cluster random sampling for all programme areas
4	Coverage Census	2004 (July 2005)	LF	Cross-sectional quantitative and qualitative	Countrywide (10) Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa and Kassena-Nankana districts, Nzema East, Agona, , Nadowli and East and West Mamprusi	30-cluster random sampling for all programme areas
5	Coverage Survey + LF Morbidity Study	2005	LF	Cross-sectional quantitative and qualitative	Countrywide (10) Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa and Kassena-Nankana districts, Nzema East, Agona, , Nadowli and East and West Mamprusi	30-cluster random sampling for all programme areas

No	Survey	Year	Disease Treatment Assessed	Method	Study Areas (Number of District)	Sampling
6	Integrated Coverage Survey	2006 MDA done in 2007 (Jan)	LF + Trachoma	Cross-sectional quantitative and qualitative	Jirapa-Lumbussie (1)	30-cluster random sampling for district
7	MDA Coverage and Non-Compliance Assessment + LF Morbidity Study	Feb 2007	LF	Cross-sectional quantitative and qualitative	Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa, Kassena Nankana (5)	30-cluster random sampling per district
8	Integrated Survey Coverage	Dec 2007	LF + Onchocerciasis + Trachoma	Cross-sectional quantitative and qualitative	Agona, Bawku East, Central Gonja (3)	15-cluster random sampling per district
9	NTD KAP Study (qualitative + quantative)	Sept 2009	LF + Onchocerciasis	Cross-sectional quantitative and qualitative	Four districts from Greater Accra, Volta, Upper West, Western (4)	30 cluster randon sampling per district purposively selected

Table 4.2: Coverage Survey Results for Year 1 undertaken in 2001

District	Reported Coverage	Surveyed Coverage	Coverage Difference (surveyed-reported)
Kassena Nankana	84.0	71.4	-12.6
Builsa	74.2	75.9	1.7
Sissala	87.4	85.8	-1.6
Awutu Efutu Senya	71.0	64.9	-6.1
Ahanta West	83.0	71.6	-11.4

Table 4.3: Year Two Coverage Survey Results

District	Reported Coverage	Surveyed Coverage	Coverage Difference (surveyed-reported)
Ahanta West	88.5%	82.0%	-6.5%
Kassena Nankana	82.2%	75.7%	-6.5%
Awutu Efutu Senya	96.7%	84.0%	-12.7%
Sissala	75.7%	88.5%	-12.8%
Builsa	79.4%	81.9%	+2.5%

Three of these districts had differences of more than 10%, which made the reported coverage for those districts unreliable. Six of the districts had the difference between the surveyed and the reported coverage less than 10%, which is within acceptable, limits making the reports from 6 districts reliable. The total national reported coverage for year 3 was 70.9% and therefore a difference of 2.5% was also noted nationally which is within acceptable limits of less than 10% making the national reported coverage reliable. Wider differences between the surveyed and reported coverage were observed at the community level. At the community level, reported coverage ranged from 47.2-91.9%, and surveyed coverage ranged from 60.4-78.8% and the difference between the surveyed and reported coverage ranged from 0-30.3%. The deviation was from 1.0% in Wogu in Nadowli district and Kubalin in Nanumba district to 31.9% in Fumbisi Central in Builsa district. Those with a difference of less than 10% were 13(N) while those with more than 10% was

17. At the community level reliability of the coverage for this survey is less than at the district and nationally.

4.5.4 Year Four Coverage Survey

The Programme completed four rounds of implementation activities with the completion of all activities for year 4 of programme implementation in the year 2004. In year 2004, the programme scaled up from 30 in year 3 to 40 of the total of then 49 endemic districts. Coverage surveys were conducted in 10 of these endemic districts, which were selected conveniently taking into consideration the presence of sentinel communities for monitoring. The coverage surveys were conducted in 10 of these endemic districts with sentinel sites for monitoring of immuno-parasitological indicators (Tables 4. 6 and 4.7).

A total of 30 communities of three each from each of these 10 sentinel districts were chosen for the coverage survey. In order to improve on the reliability of the survey of the limited number of selected communities a total community census was conducted for the coverage assessment. These 10 districts included the five start-up districts of the programme, which are Ahanta West, Awutu-Efutu-Senya, Sissala, Builsa, and Kassena-Nankana districts. The others are Nzema East, Agona, Nadowli and East Mamprusi and West Mamprusi, which came on board the programme at later phases of the programme's up-scaling plan. The survey tool was in two parts. The household head interview involved the household head or the representative and the household interview involving all members of the household. A total population of 20,912 was surveyed, 15,745 individuals had ingested the tablets with surveyed population coverage of 75.3%. The total population coverage reported was 73.9% giving a difference of 1.4% between the reported and surveyed coverage. The reported total population coverage calculated for year 4 of MDA is reliable at the national level. At the community level the surveyed coverage ranged from 50.1%-90.4%, the reported coverage ranged from 52.2-96.2% with differences, which ranged from 1.2-35.9%. Those communities with a difference or more than 10% were 18 in number and those with coverage of more than 10% 12 in number. Generally more community level reported coverage was reliable. At the district level the surveyed coverage ranged from 67.2-85.4% while the reported coverage ranged from 65.8-87.6%. The difference between the reported and surveyed coverage ranged from 1.1-20.4% with seven districts having a difference between surveyed and reported coverage above 10% and three with coverage less than 10%. The coverage reported by the programme for year 4 MDA was reliable at the national level.

Table 4.4: Year Three Coverage Survey Results by Distric

Year Three Coverage Survey Results by Districts									
		Populations					Coverage		
Region	District	Pop.	Number of Households	Reported	Surveyed	Population Treated	Reported	Surveyed	Difference
Central	AEE	1712	452	1712	1732	1139	88.8	65.8	-23.0
	AES	2226	446	2226	2004	1286	76.7	64.2	-12.5
Western	MWE	1277	185	1277	1102	736	67.0	66.8	-0.2
Western	AW	2396	347	2396	1505	1099	72.1	73.0	0.9
Upper-East	Builsa (Fumbisi)	2130	426	2130	2526	1697	70.1	67.2	-2.9
	Builsa (Chuchuliga)	1967	394	1967	2591	1976	70.1	76.3	6.2
	Builsa	4097	820	4097	5117	3673	70.1	71.8	1.7
Upper-West	Nadowli	5453	719	5453	3748	2982	64.2	79.6	15.4
	Sissala	2999	601	2999	2293	1804	70.5	78.7	8.2
Northern	Nanumba	1641	328	1870	2230	1870	83.3	83.8	0.5
	Zubzugu Tatale	1675	334	1675	1710	1153	70.0	67.4	-2.6
National		11738	2116	11853	10721	7870	70.9	73.4	2.5

Year Three Coverage Survey Results by Community

Region	District	Subdistrict	Community	Populations				Coverage		
				Population	Number of Households	Reported	Surveyed	Reported	Surveyed	Difference
Central			Badukwaa	162	37	162	141	85.2	70.2	-15.0
			Asempanyin	509	107	509	385	87.4	62.1	-25.3
			Kromain	1041	308	1041	1206	91.9	66.4	-25.5
	AjumakoEn yan Essiam	Enyan Abaasa				1712	1732			
Central			Gyangyanadze	493	99	493	440	81.1	77.5	-3.6
			Gyahadze	970	194	970	869	90.7	60.4	-30.3
			Esuakyir	763	153	763	695	86.2	60.4	-25.8
	Awutu Efutu Senya	Winneba			898	2226	2004			
			Sekyere Obuasi	635	77	635	398	47.2	71.6	24.4
			Shed	418	70	418	449	91.4	63.5	-27.9
			Noah-krom	224	38	224	255	72.3	65.1	-7.2
Western	Mpohor Wassa East	Atobiase				1277	1102			
			Asemasa	585	95	585	481	70.7	78.8	8.1
			Asemko	679	150	679	519	74.2	70.7	-3.5
			Butre	1132	102	1132	505	73.4	69.9	-3.5
Western	Ahanta West	Apowa/Busua			532	2396	1505			
			Baasa	925	185	925	976	96.4	74.8	-21.6
			Kasiesa #1	436	87	436	667	63.8	70.9	7.1
			Fumbisi Central	769	154	769	883	87.8	55.9	-31.9
*Upper-East	Builsa	Fumbisi				2130	2526			

			Achangyeri	688	138	688	1452	82.6	73.8	-8.8
			Namonsa	990	198	990	767	90.6	79.5	-11.1
			Azuayeri II	289	58	289	372	77.2	79.3	2.1
*Upper-East	Builsa	Chuchuliga			820	1967	2591			
			Issa	2117	362	2117	1761	74.3	77.7	3.4
Upper-West	Nadowli	Issa	Wogu	2573	228	2573	1332	78.7	78.7	0
			Duag	763	129	763	655	66.1	86.3	20.2
						5453	3748			
			Sorbelle	1889	378	1889	1410	65.9	77.3	11.4
			Bouti (A&B)	703	141	703	488	72.6	80.1	7.5
			Banu	407	82	407	395	62.4	81.8	19.4
Upper-West	Sissala	Nanvilli			1320	2999	2293			
			Omouldo	446	89	446	584	70	82.4	12.4
			Nyeunepale	1036	207	1036	1223	79	84.1	5.1
			Kubalim	159	32	388	423	73	85.1	12.1
Northern	*Nanumba	Kukpaligu				1870	2230			
			Lakpali	332	66	332	256	77	75	-2
			Nboble	237	47	237	240	71	60.8	-10.2
	Zabzugu		Afayili (Zab. Central)	1106	221	1106	1214	82	67.1	-14.9
Northern	Tatale	Zabzugu		4232	662	1675	1710			

Table 4.5: Year Three Coverage Survey Results by Community

Table 4.6: Year Four Coverage Survey Results by Community

Year Four Coverage by Community							
Region	District	Community	No. Sampled	No. Treated	Surveyed Coverage (%)	Reported Coverage	Difference
Western	Ahanta West	Asemasa	335	272	81.2	79.6	1.6
		Asemko	492	369	75.0	70.7	4.3
		Butre	508	357	70.3	96.2	-25.9
			1,335	998	74.8	85.8	-11.0
	Nzema East	Anwia	1,314	1,036	78.8	56.9	21.9
		Nvesolo	353	298	84.4	91.0	-6.6
		Bomoakpole	256	134	52.3	88.2	-35.9
			1,923	1,468	76.3	87.6	-20.4
Central	Agona	Kofi Kum	338	184	54.4	59.9	-5.5
		Esusu	242	158	65.3	78.4	-13.1
		Kwesi Paintsil	576	435	75.5	88.3	-12.8
			1,156	777	67.2	75.2	1.1
	Awutu Efutu Senya	Gyangyanadze	418	342	81.8	89.6	-7.8
		Gyahadze	666	530	79.6	82.5	-2.9
		Essuekyir	628	402	64.0	90.7	-26.7
			1,712	1,274	74.4	82.4	-8.0
Northern	West Mamprusi	Sayoo	1,274	1,001	78.6	83.4	-4.8
		Kpariga	1,554	779	50.1	72.9	-22.8
		Wungu	1,919	1,435	74.8	68.1	6.7
			4,747	3,215	67.7	75.4	-7.7
	East Mamprusi	Dabari	137	102	74.5	83.2	-8.7
		Namasim	1,066	854	80.1	86	-5.9

		Zaratinga	1,057	870	82.3	76.4	-5.9
			2,260	1,826	80.8	74.4	6.4

Upper East	Builsa	Kaseisa No.1	435	339	77.9	79.5	7.6
		Fumbisi Central	597	387	64.8	90.5	-25.7
		Baasa	859	725	84.4	93.9	-9.5
			1,891	1,451	76.7	74.3	2.4
	Kassena Nankana	Badunu	612	462	75.5	67.9	7.8
		Namolo Chiribia	669	410	61.3	69.4	-8.1
		Korania	732	571	78.0	74.4	3.6
			2,013	1,443	71.7	65.8	5.9
Upper West	Nadowli	Daffiama Mission	337	301	89.3	63.1	26.2
		Tuori	591	521	88.2	68.8	19.4
		Dakyie	446	351	78.7	52.2	26.5
			1,374	1,173	85.4	66.6	18.8
	Sissala	Bouti	655	542	82.8	81.4	1.4
		Sorbelle	1,566	1,325	84.6	85.8	-1.2
		Banu	280	253	90.4	71.1	19.3
			2,501	2,120	84.8	79.5	5.3
Summary	10	30	20,912	15,745	75.3	73.9	1.4

Table 4.7: Year Four Coverage Survey Results by District

Year Four Coverage Surveys Results by District						
Region	**District**	**Number Sampled (N)**	**Number Treated (N)**	**Surveyed Coverage (%)**	**Reported Coverage (%)**	**Difference (%)**
Western	Ahanta West	1335	998	74.8	85.8	-11.0
	Nzema East	1923	1468	76.3	75.2	1.1
Central	Agona	1156	777	67.2	87.6	-20.4
	AES	1712	1274	74.4	82.4	-8.0
Northern	West Mamprusi	4747	3215	67.7	75.4	-7.7
	East Mamprusi	2260	1826	80.8	74.4	6.4
Upper East	Builsa	1891	1451	76.7	74.3	2.4
	KND	2013	1443	71.7	65.8	5.9
Upper West	Nadowli	1374	1173	85.4	66.6	18.8
	Sissala	2501	2120	84.8	79.5	5.3
National Summary		20912	15745	75.3	73.9	1.4

For the five start-up districts adequate coverage of more than 65.0% has been recorded in all districts since the inception of the programme till the year four of programme implementation. Reported coverage for year four ranged from 74.4% in Awutu Efutu Senya district to 84.8% in Sissala district while surveyed coverage ranged from 74.3% in Builsa district to 82.4% in Awutu Efutu Senya district (Table 4.7 and 4.8). The deviation of the surveyed coverage from the reported coverage ranged from 1.1% in Kassena Nankana and Ahanta West districts to 8.0% in Awutu Efutu Senya districts. These deviations are below the allowable threshold of 10% implying that the coverage as reported by the districts was reliable.

Table 4.8: 2004 Coverage Survey Results for the Five Start-up Districts

Coverage Survey Results for Year Four			
District	**Reported (%)**	**Surveyed (%)**	**Difference (%)**
Kassena Nankana	75.9	74.8	-1.1
Builsa	76.7	74.3	-2.4
Sissala	84.8	79.5	-5.3
Awutu Efutu Senya	74.4	82.4	8.0
Ahanta West	74.8	75.9	1.1

Table 4.9: Longitudinal Surveys in Start-up Districts

Coverage		**District**				
		Kassena Nankana	**Builsa**	**Sissala**	**Awutu Efutu Senya**	**Ahanta West**
Year 1	Reported (%)	82.2	79.4	75.7	96.7	88.5
	Surveyed (%)	82.0	84.0	88.5	75.7	71.0
	Difference (%)	-0.2	4.6	12.8	-21.0	-17.5
Year 2	Reported (%)	84.0	74.2	87.4	71.0	83.0
	Surveyed (%)	71.4	75.9	85.8	64.9	71.6
	Difference (%)	-12.6	1.7	-1.6	-6.1	-11.6
Year 3	Reported (%)	-	-	82.7	86.0	72.8
	Surveyed (%)	-	-	67.2	66.1	73.1
	Difference (%)	-	-	-15.5	-19.9	0.3
Year 4	Reported (%)	75.9	76.7	84.4	74.4	74.8
	Surveyed (%)	74.8	74.3	79.5	82.4	75.9
	Difference (%)	-1.1	-2.4	5.3	8.0	1.1

Trends in coverage in these five start-up districts indicate that coverage as reported has generally been adequate, though deviations between reported and surveyed coverage above 10% was observed in some districts for some years. In year one, three out of these five districts had deviations of more than 10%, two out of five in year two, three out of four in year three (since Kassena Nankana district was not surveyed in year three) and none of the five districts had a deviation of more than 10% in year four demonstrating that reliability of the reported coverage had improved by year four (Tables 4.8 and 4.9).

4.6 Integrated Post-MDA Coverage Surveys for Lymphatic Filariasis and Trachoma

The first of the integrated surveys assessed MDA for LF and trachoma was conducted in year six. This integrated evaluation of mass treatment campaigns to interrupt transmission of *W. bancrofti* and blinding trachoma was conducted in the Jirapa-Lambussie district of the Upper West region after year six of implementation of annual mass treatment (Figure 4.1). It involved 30-cluster sampling in one conveniently selected district, which was co-endemic for LF and trachoma. The objectives of this survey included the determination of potential barriers to acceptance of combination drugs for MDA. Household access to water and latrines as related to the trachoma elimination campaign was also assessed. This survey assessed ivermectin and albendazole treatment for LF and azithromycin treatment for trachoma in this district. Potential barriers to community acceptance of combined administration of medicines for trachoma and LF MDA were explored as part of this study.

4.6.1 Objectives

The purpose of the survey was to conduct an integrated coverage survey to evaluate community participation in MDAs, to eliminate LF and blinding trachoma, in a co-endemic district in Ghana.

4.6.2 Methods

The study was a cross-sectional exploratory study. A two-stage cluster sampling was used to select 30 clusters of 10 households in Jirapa-Lumbussie district, which is co-endemic for both LF and trachoma (Figure 4.1). The district has a population of 96,834 (GHS, 2006). All adults in each household were interviewed using a short questionnaire with visual aids of the tablets used in the mass treatment programme to identify reasons for participation and non-compliance as well as their views about taking the drugs together in a combined distribution. All adults 18 years and older in each household were interviewed using a structured questionnaire after informed consent had been obtained from participants. In addition, a few household observations relating to LF and trachoma interventions were made by the interviewers with the consent of the head of household. This survey was conducted prior to the implementation of the integrated NTD Control Programme.

Coverage of water supply was 84% but people still do not have adequate access to potable water. The supply systems available in the district include piped water, boreholes and hand-dug wells. Individuals without access to potable water resort to unprotected sources of water. Poor sanitation continues to be a major problem in the District (Government of Ghana, 2012).

4.6.3 Results

Clusters of 10 households were sampled per community and in all 299 households were interviewed. Information on a total of 1,435 people, comprising 773 children under 18 years old and 662 adults above 18 years, was collected. A total of 2,435 people were sampled. The district reported coverage of MDA for LF using ivermectin and albendazole 93.0% while the surveyed coverage was 82.0%. The deviation of the surveyed coverage from the reported coverage was 11.0% which is more than the allowable difference of up to 10% (WHO, 2000; 2006).

Treatment coverage of 63.8% was achieved among the under-18 year old members of the households during the survey. Among the adults above 18 years, coverage of 68.9% was recorded from the survey. The overall district-surveyed coverage observed was 66.9% for the trachoma treatment. The district reported overall treatment coverage of 92.5%. The reported coverage for the trachoma treatment is unreliable since it is way above the surveyed coverage and also falls outside the 5% margin of error (Table 4.11). The results of the surveys of the MDA coverage for both LF and trachoma showed a district difference of 11.0% and 25.6% respectively. The reported coverage of both treatments are in themselves unreliable since it is estimated that the ineligible population is estimated between 15-20% so coverage is not expected to be higher than 85%. However, these reported coverages are significantly higher than 85% while the deviation of the surveyed coverage from the reported coverage are more than 10% in both cases indicating that coverage as reported by this district is unreliable.

Table 4.10: Results of Post-MDA Round 6 Integrated Coverage Surveys

Round 6 Post MDA Integrated Coverage Survey for LF and Trachoma					
District	**Sub-District**	**Community**	**Surveyed**	**Reported**	**Difference**
Jirapa-Lumbussie	Jirapa	Talagona	63.6	62.4	-1.2
		Gbare	79.2	73.5	-5.7
		Kuchene	88.5	97.5	9
		Komporo	77.8	93.5	15.7
		Baazu	81.3	95.1	13.8
		Ving-Ving	88.1	76.2	-11.9
	Hamile	Sigri	77.3	94.6	17.3
		Muoteng	64.3	97.2	32.9
	Han	Han	58.3	97.0	38.7
		Kenne	82.4	85.1	2.7
		Deriyiri	75.8	97.1	21.3
		Chapuri	88.4	94.2	5.8
	Piina	Kpare	88.9	81.4	-7.5
		Gberikuo	71.4	95.3	23.9
		Piina	80.6	98.5	17.9
		Tabier	84.0	95.9	11.9
	Samoa	Gbal	89.5	86.0	-3.5
	Tuggo	Buboo	83.3	85.5	2.2
		Konzokala	91.3	95.8	4.5
		Doggoh	79.1	97.1	18
		Kul-ora	81.4	63.1	-18.3
		Kanne	85.5	86.1	0.6
	Ullo	Mwofopaala	80.0	96.8	16.8
		Taayaaguri	98.5	95.1	-3.4
		Nabiri	77.8	97.6	19.8
		Ul-Kpong	91.8	98.9	7.1
	Yagha	Yagha	92.6	97.6	5
		Tie	77.5	93.3	15.8
		Boyelle	79.5	96.7	17.2
District Summary			82.0	93.0	11.0

Table 4.11: Surveyed and Reported Coverage

Disease	Surveyed Coverage (%)	Reported Coverage (%)	Difference(%)
Lymphatic Filariasis	82.0	93.0	11.0
Trachoma	66.9	92.5	25.6

4.7: Knowledge, Attitude and Practice Survey for Lymphatic Filariasis and Trachoma

4.7.1 Lymphatic Filariasis (LF)

Some 584 adults were interviewed for the assessment of their knowledge about the LF. Majority (33.6%) had heard about the disease from the radio, while 23.1% heard about the disease from health workers. About 55.5% of the respondents associated LF with big feet, 7.9% with the mosquito, while 1.5% knew nothing about the disease, however most (89.4%) of respondents had seen a patient with a big leg before which they associated with LF. Most (63.2%) people indicated that LF could be treated with medicines. Though 80.1% of respondents had seen a patient with a big scrotum before, only 48.3% knew it could be treated with surgery. The majority (68.7%) of respondents knew taking tablets could help prevent the disease while other means of prevention included sleeping under mosquito nets (29.3%). Misconceptions about its prevention remained common among respondents.

Majority of the people (94.3%) remembered the LF drug distribution carried out in the community for the year six and 88.5% of them remembered taking the tablets. Most (85.3%) of them were given the tablets by community volunteers and the others received them from health workers. Among those who had taken the treatment, 2.2% had taken the drugs once; 19.2% have taken it 2 times; 49.1% have taken it three times; 10.6% have taken it four times; 5.8% have taken it for five times; 7% of those questioned did not remember ever taking ivermectin and albendazole during the mass treatment exercise. Most (88.7%) of the respondents indicated that they took the ivermectin and albendazole to prevent them from becoming infected with LF. About 16.3% of the respondents said they took the drugs in order to stay healthy while 8.2% took the drugs to stop the spread of LF. Other reasons for taking the drugs included the desire to feel better (0.9%), others (1.4%) took the drugs because they were free while a few (0.7%) took the drugs for no reason. Most of the interviewees (82.9%) indicated they had complied with treatment since MDAs started. Apart from those who were ineligible for the treatment other reasons given for not taking the treatment among the non-compliers included absenteeism, fear of side reactions and unwillingness to take orthodox medicines. Others said the CDD did not cover their area with the treatment.

4.7.2 Trachoma

Majority (81.8%) of respondents knew about trachoma as a disease and 51.4% associated it with blindness out of the 62.8% who knew the disease affected the eyes. Direct involvement of health workers in providing education for communities members seem to be low (27.4%) since majority (49.0%) heard about the disease from the radio. Only 2.9% of respondents were aware of the availability of surgical treatment for trachoma while 11.3% knew about the use of face washing. However as regards prevention, respondents said it depended on taking of medicines (49.3%), face washing (40.2%), personal hygiene (34.9%) and environmental cleanliness (34.4%). On the whole, 84.1% of respondents indicated that trachoma was a problem in their communities.

About 78.1% of respondents remembered trachoma treatment with azithromycin taking place in their communities in year six while 66.1% had participated in the treatment which was said to have been administered by a community drug distributor by 64.6% of respondents while 8.9% said health workers. About 12.2% of respondents had taken the azithromycin once, 18.7% twice, 27.2% three times, 7.2% four times while 6.2% could not tell. Similar reasons for taking or not taking ivermectin and albendazole were assigned to taking azithromycin. Among the children, 56.4% cleaned their faces. Children in 35.1% of the households washed their faces more than once a day but 4% washed their faces once a day and 52.5% wash once a week. Methods of disposal of faeces were poor. About 75.9% of households disposed of stools from children into the environment outside the homes, 1.3% just left them standing in the homes while only 1.3% of households disposed off stools from children properly into latrines.

Some 73.6% of respondents said they were willing to take the drugs ivermectin/albendazole and azithromycin tablets in combination. Those who were not willing to take the tablets in combination said they were afraid they would get sick (30.1%). About 17.8% of respondents think the drugs would make them weak; 2.4% said they cannot swallow all the tablets; 9.4% think the tablets would be too many to take at a time; 1% do not like taking medicines. Majority (93.6%) respondents accessed boreholes as their main source of water. About 4.3% of them use surface water, 1.3% use unprotected wells, 0.3% use an unprotected spring and another 0.3% use rainwater. Access to toilet facilities was low (10.7%) while 4% of household members did not use the available toilet facilities (table 3). Many people defaecate in the bush or in open spaces. Houses in the communities are so dispersed and therefore the facilities available even for the communities are so far away from most of the people and they therefore find it more convenient to use the bush or open spaces around the houses.

4.8 Discussions, Conclusions and Recommendations

For this integrated survey 30-clusters of ten households were selected from ten sub-districts of the districts. A total of 2,435 people were sampled. Coverage of 82% and 66.9% were obtained for the LF and trachoma treatments respectively in the survey. These coverage figures compared to the reported coverage figures of 93% and 92.5% for LF and trachoma respectively. These results show that the reported coverage for both diseases are unreliable since the difference between the reported and surveyed coverage are above the 10% acceptable threshold. However, it needs to be ascertained whether the coverage as reported was the eligible coverage and not the total population coverage as reporting requires. The district health administration is likely to have reported eligible coverage while the 82% and 66.9% obtained from the survey is indicative of the total population coverage. A check on the coverage report shows that most of the ineligible population was not captured in the report and did not form part of the denominator. Majority of the people (73.6%) interviewed were willing to accept the combination drug administration with the only barrier being the fear of possible side reactions from the combined drugs which individually produced some known reactions.

The reported treatment coverage for LF and trachoma for the Jirapa-Lambussie district are unreliable. There is, therefore, the need for effective monitoring and supervision by district and regional officers to ensure efficient treatment and reporting. Also, district officers to ensure that the reports collated and sent to the region are reliable should verify reports by community volunteers. Again the region should verify reports from the district to ensure that figures being sent to the national office were reliable. There should also be further training of volunteers to ensure proper reporting, and volunteers and health staff be monitored to prevent falsification of reports. Members of the communities had high levels of awareness of LF and trachoma, and their treatment and prevention. Radio (73.2%) was the main source of information in the district. The major concern of these people is the number of tablets and the fear of side reactions. Threat to the control of trachoma in the district is mainly the lack of access to toilet facilities in the communities, forcing most of the people to defecate in the bush and in the open providing the habitat for the breeding of *Musca sorbens* (Emerson et al, 2004) the flies involved in the transmission of trachoma. For the programme to eliminate trachoma to succeed there is the need for the provision of enough facilities for appropriate waste disposal for the communities.

Most people are willing to accept the combined administration of drugs for the treatment of LF and trachoma. Intensive and appropriate education should be carried out prior to the implementation of the combined drug administration programme so as to allay the fears of the people about a possible reaction to the different tablets to be taken together. Strategies to ensure compliance with combination drug treatment need to be carefully designed taking into consideration the concerns of the community members.

4.9 Round 7 Post MDA Integrated Coverage Assessments for Lymphatic Filariasis and Trachoma

The first year of implementing the integrated NTD programme for the preventive chemotherapy diseases involved five regions - Western, Central, Upper East, Upper West and Northern regions. This was started in year 7 (2007) following the initial implementation of the LF elimination programme from 2000 to 2006. The type of package administered was based on the endemic status of the regions or districts involved. The drug packages for this round of MDA implementation were ivermectin and albendazole for LF only or in combination with onchocerciasis treatment, Zithromax/Tetracycline and ivermectin/albendazole for trachoma and LF only or in combination with onchocerciasis treatment and ivermectin only for onchocerciasis. This survey was undertaken as a longitudinal monitoring activity of MDA essential for assessment of the progress of the preventive chemotherapy programme. It helps identify poor treatment coverage in order for timely and appropriate interventions to be undertaken to improve coverage and eventually reduce immune-parasitological indicators.

The objectives of the post-MDA treatment survey were;

1. To validate reported coverage rates
2. To determine age and gender specific coverage
3. To collect information on reasons for non-participation of endemic community members in MDAs to inform future implementation of advocacy and IEC strategies
4. To collect information on the activities of CDDs

4.9.1 Method

The second integrated coverage survey employed three districts conveniently selected from three categories of districts. The selection of these districts was based on the coverage obtained in the last MDA. This survey assessed LF, onchocerciasis and trachoma MDAs. The 3 districts, which are Agona in the Central region, Central Gonja in the Northern region and then Bawku West in the Upper East regions, were conveniently selected for this survey. These districts therefore represent areas, which either had a high (80% or more), medium (65% to less than 80%) or low (less than 65%) coverage as shown in Table 4.12. Agona and Bawku West districts were endemic for LF while Central Gonja was endemic for LF and trachoma.

Table 1.12: Selected Districts for the Second Integrated Coverage Surveys

Performance	Low performing	Average performing	High performing
District	Agona-Central region	Central Gonja-Northern region	Bawku-West-Upper east region
Drug Treatment Package	Ivermectin/Albendazole	Ivermectin/Albendazole and Azithromycin	Ivermectin and Albendazole
Coverage	41.6%	70%	83%

Twelve communities (Table 4.13) were randomly selected from each of these districts. Compound selection was done by first demarcating the community into sections with the help of the local health staff. The centres of the small communities or of sections of larger communities were identified during the survey and the field workers identified and trained assembled there. A pencil/pen was spun in the centre and field workers directed based on the direction of the pencil pointer. The first compound encountered in that direction was entered and one household interviewed within that compound. Households were randomly selected and in order to obtain a minimum population size of 254 per community, a minimum of 43 households were selected for each interview. The household questionnaire was in two parts. The first part was applied for interviewing the head of the household and all members of the households interviewed with the second part. In addition to the household surveys, all community drug distributors who were available during the survey were also interviewed using a second questionnaire designed for the community drug distributor's interviews.

4.9.2 Presentation of Results

In total 36 communities were selected from a total of 16 sub-districts for the survey. The total number of people surveyed in all the three districts together was 9,296. About 2502 people were surveyed in Agona, 3203 people from Bawku West and 3,591 people from Central Gonja (Table 4.13). Comparing the surveyed coverage to the reported coverage for ivermectin and albendazole treatment shows that surveyed performance in the districts was actually better than what was reported to the programme. Apart from Bawku West where the difference between the reported district coverage and the surveyed coverage was just 4.4%, Agona and Central Gonja had differences of 21.3% and 15.8% respectively which are higher than the WHO acceptable difference of 10% (Table 4.13). These significant positive differences between the reported and surveyed coverage might be due to the submission of earlier incomplete reports to the programme which were never updated.

A total of 1673 (18.0%) individuals out of the total registered population did not take the drugs for various reasons. Of this number 794 (47.5%) were in Agona, 389 (23.3%) from Bawku West and 490(29.3%) from Central Gonja. Among those who did not take the drugs were those who belonged to the ineligible population who formed about 45.1% of the total surveyed population. Among those that were eligible but were not treated, 47.5% (Table 4.14) were absent for various reasons and formed the largest proportion of eligible population that was not treated. The rest either refused the treatment for fear of side reactions or did not know about the treatment programme. This, therefore, suggests that the timing of the MDA needs to be reviewed to ensure that absenteeism is reduced to the barest minimum. In order to minimize other refusals and apathy towards mass drug distribution often due to community fatigue from several years of experiencing mass drug distribution, it is also suggested that more innovative behavioural change communication strategies be designed, adopted and implemented as part of the programme.

4.10 Household Head Survey

The household head survey involved interviews with 1756 household heads or their representatives. About 32.9% of the total number was interviewed in Agona, 24.8% from Bawku West and 42.3% from Central Gonja (Table 4.13). The majority (84.9%) of the household heads interviewed were aware of the drug distribution programme and also aware that the drugs prevented LF. Another 23.9% knew the drugs were also for onchocerciasis, which is representative of those that live in the onchocerciasis endemic areas, 20.4% knew the drugs were also for trachoma, 24.7% knew the drugs prevented STH and 0.6% wrongly thought the drugs also prevented schistosomiasis (Table 4.15). These findings demonstrate that the health education component of the programme had been well received and understood and the endemic status of the communities in which they lived. About 4.7% of the respondents mentioned other diseases the different drug packages prevent and included cancer, cholera, leprosy, malaria, polio, sickle cell disease and stroke among others. Though this is a small proportion of respondents, the need to target everyone with improved health education becomes essential in order to achieve target coverage of 100% of all the eligible (approximately 80% of the total population) people with the drug treatment exercise. About 83.8% of the respondents perceived themselves to be at risk of acquiring infection with the diseases prevented by the different drug packages while 15.0% said they were not at risk. About 2.1% did not know and could be added to the category of those who said they were not at risk of these diseases. About 47% respondents said people refused the treatment, while 37.2% said people did not refuse the treatment. About 15.8% did not know about the treatment (Table 4.14). Based on these responses, it can be deduced that though a large number of people consider themselves to be at risk of the diseases, many people might be refusing the treatment for various reasons. This perception of risk according to the survey did not match participation of the household heads in MDAs by matching number of times drugs have been distributed and number of times it has been taken.

Awareness and compliance with drug distribution over the period of implementation of annual MDAs by the household heads was not encouraging. Agona district completed five rounds of MDA prior to this survey while both Bawku West and Central Gonja had completed four rounds. Most of the household heads were aware of three rounds of MDA, followed by two rounds before four rounds of MDA. Participation in MDAs by these household heads seems to follow a similar trend. Most of the household heads interviewed had participated only twice, followed by those who had participated three times and then four times (Figure 4.2). Household heads play the role of breadwinners in the home making their availability for participation in the MDAs limited, however, for a major activity like MDAs it is expected that other household members would inform them of the exercise.

4.11 Community Drug Distributor's Survey

Forty eight CDDs were also interviewed as part of this year seven post-MDA survey. In all only nine of the 39 CDDs were female. Majority (85.4%) were married, were mainly farmers (45.8%) and mostly Christians (56.3%). Most of the CDDs were educated as expected since the work of CDDs requires some level of education to understand the disease, transmission and treatment in order to provide some health education with the treatment. They are expected to be able to dose, record and report appropriately. Though, only 4.2% of the CDDs had had tertiary education, as many as 79.2% had had secondary education. About 8.3% had only primary education while another 8.3% had had no education. In contrast to the above findings of the household survey as many as 97.9% of the distributors knew the drugs prevented LF, 43.8% knew the drugs prevented onchocerciasis and 16% knew the drug prevented trachoma (Figure 4.17). About 43.8% also knew the drugs prevented the soil transmitted helminthiasis while none of the CDDs interviewed said the drugs they administered prevented schistosomiasis.

Table 4.13: Comparison of Surveyed and Reported Coverage for Second IntegratedCoverage Surveys

District	No of clusters surveyed	No of households surveyed	Surveyed population	Population that ingested the drugs	Surveyed coverage (%) by district	Reported coverage by district	Difference (surveyed coverage – reported coverage) by district
Agona	12	577	2502	1575	62.9	41.6	21.3
Bawku West	12	581	3203	2800	87.4	83	4.4
Central Gonja	12	598	3591	3080	85.8	70	15.8
Total	36	1756	9296	7455	80.2		

Table 4.14: Reasons for Non-compliance for Second Integrated Coverage Surveys

Reasons for not taking the drugs		**District**			
		Agona	**Bawku West**	**Central Gonja**	**Total**
Not Eligible	Height less than 90cm	275	105	151	531
	Pregnant/lactating	64	41	78	183
	Seriously Sick	19	14	7	40
	Sub-Total	358	160	236	754
	Proportion (%)	45.1	41.1	48.2	45.1
Eligible, but did not take the drugs	Refused (Fear of side reactions)	15	6	24	45
	Did not know	56	24	0	80
	Absent	365	199	230	794
	Proportion (%)	46.0	51.2	46.9	47.5
	Other	51	5	0	56
	Sub-Total	436	436	436	436
	Proportion (%)	54.9	112.1	89.0	26.1
Total		794	389	490	1673

Table 4.15: Household Heads' Knowledge about Diseases Prevented by Mass Drug Administration

	Yes		No	
Diseases Prevented	**Number (N)**	**Percentage (%)**	**Number (N)**	**Percentage (%)**
Lymphatic Filariasis	1490	84.9	200	11.4
Onchocerciasis	420	23.9	1270	72.3
Trachoma	359	20.4	1331	75.8
Schistosomiasis	11	0.6	1679	95.6
STH	433	24.7	1257	71.6
Others	83	4.7		

Table 4.16: Risk Perception of Household Heads

Parameter	Yes		No		Don't Know	
	Number	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
At risk of diseases	1472	83.8	263	15.0	21	2.1
Did people refuse treatment	826	47.0	653	37.2	277	15.8
Want drugs distributed same way	1508	85.9	171	9.7	53	3.0

Figure 4.2: Participation of Household Heads in MDAs

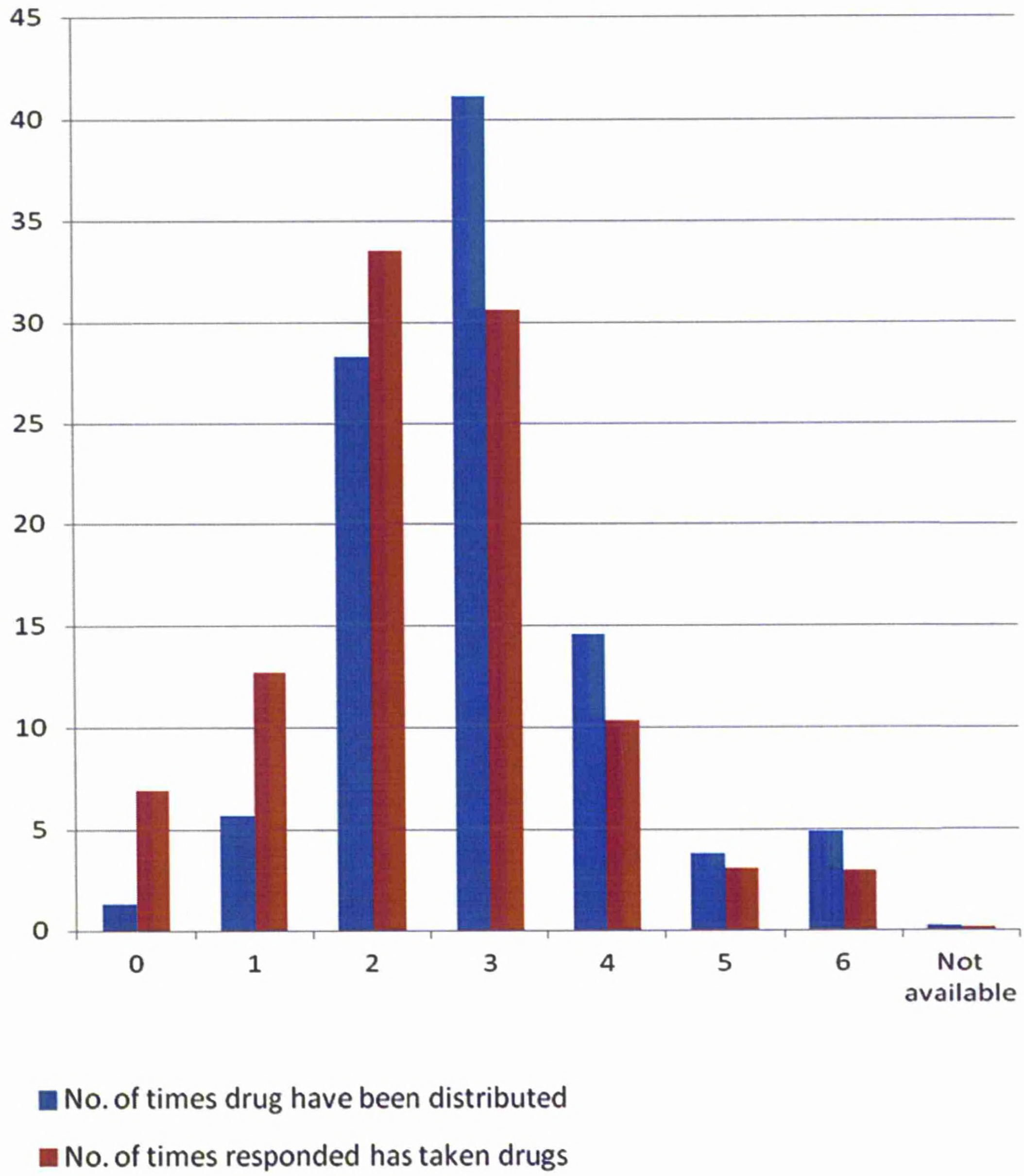
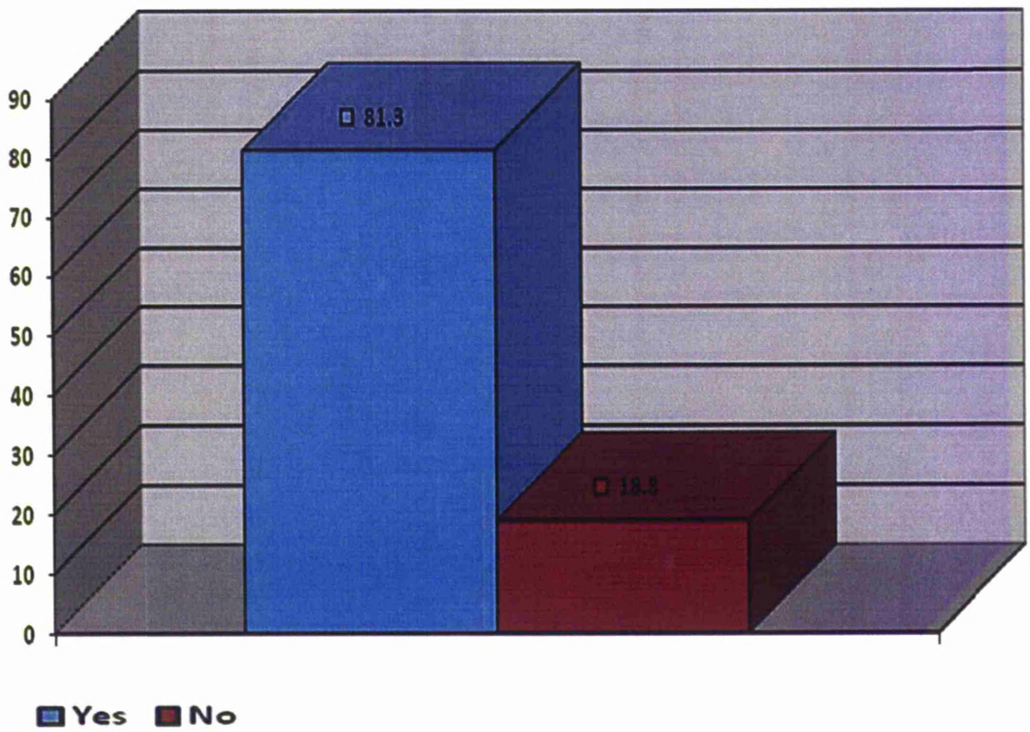


Table 4.17: Community Drug Distributor's Knowledge about Diseases Prevented by MDA

Diseases Drugs Prevent	Yes		No	
	Number (N)	Percentage(%)	Number (N)	Percentage (%)
LF	47	97.9	1	2.1
Onchocerciasis	21	43.8	27	56.3
Trachoma	16	33.3	32	66.7
Schistosomiasis	0	0	48	100
Soil Transmitted Helminthiasis	21	43.8	27	56.3
Others	4	8.3	44	91.7

Figure 4.3: Risk Perception among the Community Drug Distributors



Most of the CDDs (81.3%) considered themselves to be at risk of the diseases they were helping to distribute drugs for. The challenge here to the programme is that as many as 18.8% of CDDs might not be able to convince community members to take the drugs since they themselves did not perceive the community to be at risk of the diseases they distributed for (Figure 4.3).

There was a direct relationship between the number of times the CDD had distributed the drugs and the number of times they themselves have taken the medicines (Table 4.18) implying that CDDs themselves complied well with the drug treatment programmes they worked for. The same proportion of CDDs, who had distributed the drugs six or eight times, had also taken the treatment the same number of times. About 27.1% of the CDDs had distributed drugs three times and 31.3% had also taken the drugs three times, 22.9% and 20.8% and also 16.7% had distributed the drugs 6 times and the same proportion had again taken the drugs six times. The fact that most of the CDDs had distributed the drugs fewer times than the drugs had been distributed in those districts is indicative of the attrition rate of these CDDs which establishes the need for the annual refresher training programmes prior to the drug distribution exercise (Table 4.18).

Table 4.18: Community Drug Distributor's Participation in Taking of Medicines themselves

Number of times CDDs distributed drugs		Number of times CDD has taken drugs	
Number (N)	**Percentage (%)**	**Number (N)**	**Percentage (%)**
13	27.1	15	31.3
11	22.9	10	20.8
8	16.7	8	16.7
7	14.6	8	16.7
6	12.5	6	12.5
3	6.3	1	2.1

The reasons given by 72.3% of the CDDs who had indicated that people refused the treatment included politicization of the treatment programme, religious reasons, inability to abstain from alcohol on the day of the treatment and low risk perception among some individual community members.

Almost all (97.9%) of the distributors had received training for the job and 89.6% thought the training was adequate. About 93.8% said they had been trained to do health education while a smaller proportion of the 91.7% had actually been involved in health education (Table 4.17). Tools for undertaking health education were available to 60.4% of the CDDs while 31.3% complained of non-availability of tools for undertaking health education. All (100%) of the distributors had applied the house-to-house distribution method for undertaking the distribution exercise and treatment was also directly observed (100%) by the CDDs. Ironically 20.8% of the CDDs had also left drugs at home for persons who were absent during the exercise. All 48 CDDs interviewed (100%) had used the dose poles to determine the dosage for drug administration. About 95.8% of the CDDs had been involved in other health programmes which included polio (77.1%), Vitamin A distribution (35.4%), the anti-malaria programme, HIV/AIDS control programme activities and others such as measles immunization, family planning and guinea worm programmes (Figure 4.7). The number of distributors that worked in the communities visited for the surveys varied from one to ten. Most (35.4%) of the distributors had worked in communities, which had two distributors which is the average for most communities. Only 56.3% of the CDDs thought the number of CDDs that had worked communities were adequate in-terms of numbers. About 85.4% of the CDDs interviewed had received reports of side effects. These included itching (52.1%), rashes (41.7%), fever (85.4%), headaches (10.4%), Muscle pains (8.3%), dizziness (14.6%), vomiting (4.2%) and diarrhoea (16.7%). Other side effects reported included abdominal pains and swellings of various parts of the body. Some 31.3% of the respondents' reassured patients who suffered the side reactions, 58.3% referred the patient to the health centre, and one person representing 2.1% personally took the patient to the health centre while another 2.1% did other things such as personally administering piriton, an anti-allergic drug to the patient.

All the CDDs interviewed said they would continue to work as distributors for the following reasons which included that the work was important for the health of the community (89.6%), 20.8% saw it as part of their work, 4.2% mentioned that they like the allowances that came with the work, while 14.6% gave other reasons such as the acquired skills, others enjoyed the voluntary work, they enjoy the voluntary work and some also said "they were married to their communities," meaning they felt strongly attached to the community so much so that they would do anything to keep their communities in good health.

The CDDs interviewed had many suggestions to help improve the quality of future mass drug distribution exercises. About 10.4% suggested the need to recruit more distributors, 8.3% wanted the programme to make sure that there were adequate tablets of the drugs for distribution, 4.2% said there was the need to train all distributors while others specified the need to properly motivate CDDs by providing allowances or increasing the per-diems paid and also providing logistics such as bicycles, rain coats and boots. They also suggested that drugs should be distributed early, made available to everybody and some tablets left behind for absentees. They also requested that CDDs should do re-visits to provide treatment to absentees. Proper management of side effects should also be done through health education and provision of free treatment to those who displayed side reactions were also mentioned.

Most of these CDD survey findings are indicative of the need to improve on the content of the training provided to CDDs without unnecessarily overloading them. Monitoring and supervision of activities of the CDDs is just as important considering the limited skills they have in carrying out the tasks involved in accomplishing MDA. Communities should be also guided to undertake some self monitoring, especially of the activities of their local CDDs, to ensure that the right things were done.

4.12 Knowledge, Attitude and Practice (KAP) Study of Preventive Chemotherapy Neglected Tropical Diseases in Ghana

Integrated MDAs started in 2007, before then the onchocerciasis programme had already started in 1999 with lapses in both geographic and therapeutic coverage, the LF programme started in 2000 and had successfully completed 8 annual rounds of MDAs in 2008, Soil Transmitted Helminthiasis undertook a round of nationwide treatment in 2007 targeted at the school children. The first Schistosomiasis treatment took place in 2008 after an initial countrywide mapping. Since the inception of the integrated NTDs programme in 2006, the programme has continued to use disease specific IEC materials as part of its behavioural change communication strategy.

Disease specific materials developed in the past needed to be reviewed, updated and combined for the entire integrated preventive chemotherapy programme. Trachoma is endemic in only two regions and the programme has recently interrupted transmission but has a backlog of trichiasis cases that require surgical interventions in order to ensure total elimination of trachoma from the country. The main strategy of the NTD Disease Control Programme is PCT based largely on the common factors associated with mass drug delivery for each of these five PCT diseases namely LF (the focus of these thesis), onchocerciasis, soil transmitted helminthiasis, schistosomiasis and trachoma. Implementing an effective communication strategy will involve determination of the factors associated with MDA acceptance. Both community and school based surveys will be conducted in this study. However, to enhance the uptake and participation by the communities in these surveys and in the MDA information on community perspectives of these diseases and MDA will be required to inform the process of developing the communication strategies.

This study therefore sought to determine the actual and desired sources of awareness and information about MDA activities and the perceptions of community members on MDA activities in both school based and community settings. The attitudes of community members to implementers of the MDA activities affect their participation in the treatment exercise and therefore such determination will help identify barriers to successful implementation of MDA. Health education has also played a key role in communities understanding the causes, signs and symptoms, prevention, and treatment for each disease of these preventive chemotherapy diseases. Lack of this understanding influences the perception of community members of these diseases and the distribution programmes and hence their health seeking behaviour. The actual and desired sources of awareness and information about these diseases, their prevention and treatment are equally essential in the design of information and communication strategies. The use of acceptable of commonly used channels of communication to communities contributes significantly to success rate of such strategies. Through these tools for effective communication and information on MDA to communities and schools can be identified and implemented.

The main objective of this survey was to determine the knowledge and information gaps of the NTDs and MDA process and activities in Ghana.

4.12.1 Method

This study was a cross sectional survey of knowledge, attitude and practice of community members on four selected NTDs (LF, Onchocerciasis, Schistosomiasis, and Soil Transmitted Helminthiasis) in four regions of Ghana. This was an exploratory cross-sectional survey that applied both quantitative and qualitative methods. The country was divided into zones based on the number of NTDs prevalent in each zone. From each zone, one region was purposively selected to represent regional difference (Figure 4.4). A district was then selected randomly within the region.

Upper West region was selected from zone one where all five NTDs (LF, onchocerciasis, schistosomiasis, soil transmitted helminthiasis and trachoma) are endemic. Sissala district was randomly selected from the Upper West region. Western region was selected as one of four regions endemic for LF, onchocerciasis, schistosomiasis and soil transmitted helminths from zone 2 and Tarkwa/Nsuaem district randomly selected. From zone 3, which is endemic for onchocerciasis, schistosomiasis and soil transmitted helminths, the Volta region was selected because Ashanti region has similar demographic characteristics to the Western region. Hohoe district was subsequently selected. The Greater Accra Region (GAR) was selected because it was the only region in zone 4 endemic for LF, schistosomiasis and soil transmitted helminths, Ga East district was randomly selected from this region.

4.12.2 Sampling Method

A total of 840 households were selected for this study. The EPI "30 x 7" cluster sampling method was used for selection of sites for the quantitative data collection for each district. In each cluster, 7 households were selected at random and interviewed using a structured questionnaire. A total of 210 households for each selected district in a region were sampled. Focus group discussions (FGDs) and In-depth Interviews (IDIs) were used for the qualitative data collection. Six community level FGDs were conducted for men, women and school aged children (1 male group and 1 female group). Six IDIs were conducted with CDDs, teachers and opinion leaders. In all, a total of 24 FGDs were conducted for the entire study. Ethical clearance was sought from the Ghana Health Service Ethics Review committee. Informed consent was also sought from communities and participants at all the major phases of the study. Data storage, analysis and reporting were done in formats that did not reveal the identity of study respondents.

4.12.3 Presentation of Results

In all 210 respondents were selected from each of the four study areas. This gave a total of 840 respondents in the study. Out of this, 318 (37.9%) were aged 45-65, 223 (26.5%) were aged 25-34 and 219 (26.1%) were between 35-44. More males 447 (53.2%) were recruited than females 393 (46.8%) largely because most household heads were males. Close to three quarters 598 (71.2%) were married.

Table 4.19: Demographic characteristics of Respondents for Knowledge, Attitude and Practice (KAP) study

	Region			
Sex:	**Greater Accra**	**Volta**	**Upper West**	**Western**
Male	88(41.9%)	108(51.4%)	147(70.0%)	104 (49.5%)
Female	122(58.1%)	102(48.6%)	63(30.0%)	106 (50.5%)
Level of Education:				
Primary School	43 (20.5%)	44 (21.0%)	22 (10.5%)	29(13.8%)
Middle School	40 (19.0%)	72 (34.3%)	4 (1.9%)	47(22.4%)
Junior High School	53 (25.2%)	38 (18.1%)	10 (4.8%)	46(21.9%)
Senior High School	29 (13.8%)	22 (10.5%)	6 (2.9%)	22(10.5%)
Vocational/Technical School	8 (3.8%)	4 (1.9%)	0 (0.0%)	4(1.9%)
Tertiary	5 (2.4%)	14 (6.7%)	3 (1.4%)	2(1.0%)
None	29 (13.8%)	15 (7.1%)	164(78.1%)	59(28.1%)

Other	3 (1.4%)	1 (0.5%)	1 (0.5%)	1(0.5%)
Main Occupation:				
Industry	2(1.0%)	1(0.5%)	0(0.0%)	4 (1.9%)
Farming (fish, animal, crop)	15(7.1%)	121 (57.6%)	179(85.2%)	127 (60.5%)
Public/civil servant	1(0.5%)	7 (3.3%)	5(2.4%)	4(1.9%)
Artisan	32(15.2%)	27(12.9%)	4(1.9%)	7(3.3%)
Trading	99(47.1%)	39(18.6%)	13(6.2%)	48(22.9%)
Manual Labour	9 (4.3%)	1(0.5%)	1(0.5%)	0(0.0%)
Unemployed	16(7.6%)	8(3.8%)	4(1.9%)	11(5.2%)
Student	9(4.3%)	2(1.0%)	2(1.0%)	1(0.5%)
Others	27(12.9%)	4(1.9%)	2(1.0%)	8(3.8%)

Most respondents 622 (74%) were Christians, 161(19.2%) were Moslems, 40(4.8%) did not specify their religion and 17 (2.0%) were traditionalist. More than half 442 (52.6%) of the respondents were farmers, engaged in fishing, animal or crop farming and traders formed 199 (23.7%) of the total sample. Household heads interviewed were mostly male (70.0%), while those interviewed in the Volta and Western regions had an almost equal sex ratio of 1:1; however many more women (58.1%) than men (41.9%) were interviewed as household heads in the Greater Accra region.

Among the four regions, the one with the lowest education among the household heads is the Upper West region with 78.1% having no education, followed by the Western region with 28.1%, then the Greater Accra Region with 13.8% and finally the Volta region with 7.1%. Household heads have considerable influence on their household members in terms of education and their participation in health programmes. Education gives them a better understanding of issues and likely to enhance their participation. On the other hand, educated households have found it difficult to accept treatment from people with less education than themselves, as is often the case with community-directed drug distributors. Unemployment among these household heads was highest in the Greater Accra region (7.6%), followed by the Western region (5.2%), then the Volta region (3.8%) and finally the Upper

West region with the lowest unemployment rate of 1.9% among these household heads interviewed. Except in the Greater Accra Region, which had the lowest proportion of household heads being farmers (7.1%), in the other three regions farming was the main occupation of most of the household heads interviewed.

4.12.4 Common Health Problems

During the qualitative data collection respondents mentioned various conditions (fever, malaria, headaches, stomach aches, bodily pains, jaundice, eye problems, skin rashes, ring worms, boils, Buruli ulcer, swollen scrotum, measles, goitre, swollen leg, shingles, tooth ache, piles, stroke, coughs and colds, high blood pressure, and chicken pox) as the common health problems in their communities. Partial and total blindness was also mentioned as a major health problem in a few of the study communities. While most of the above mentioned health problems were not mentioned in every community, malaria was mentioned as a major health problem during almost all the interviews.

Though NTDs were also mentioned as health problems, they did not come up in most of the responses until they were specifically inquired about. However, in almost all the IDIs and FGDs from the Upper West most of the NTDs came up spontaneously but schistosomiasis was seen not to be a common phenomenon among community members interviewed.

The 'neglect' suffered by the NTDs does not only emanate from policy makers. Communities that suffer these diseases do not appreciate these diseases as the most important conditions they suffer and which require attention from individual community members and therefore their participation in their control activities especially MDA is affected. The onus, however, lies on government, particularly the Ghana Health Service, through its implementation activities to help them to appreciate the importance of these diseases, as has been the case with the other diseases such as malaria.

4.12.5 Sources of treatment

When the signs are recognized, victims or caregivers usually take various actions depending on the signs and seriousness of the disease. The type of treatment to be sought depended on the perceived cause of illness. Those who perceived that the causative agent is pathological sought orthodox or herbal treatment and those who perceive the disease to be caused by spells sought treatment with spiritualists. Though the use and availability of herbal preparations as well as faith healings in the communities are common and are practiced, orthodox treatments are the predominant sources of treatment for both public and private health facilities. However, in some cases, combinations of all are practiced.

The role played by spirituality in the lives of many Ghanaians cannot is important. In such situations therefore, such persons could be made to appreciate that inasmuch as they sought spiritual attention for ailments this could be married with orthodox medicine safely making them stand to benefit from both. Spiritualists could also be employed, trained and used as channels for disseminating health information on these diseases to enhance acceptance of MDA for the NTDs. Strategies for engaging spiritualists should be designed as part of the programme's IEC/BCC strategies.

4.12.6 Mass Drug Administration

Out of the total number of 840 household heads interviewed, 739 (88.0%) said they were aware of drug distribution in their communities including schools, while 101 (12.0%) said they were not aware of drug distribution in their communities. Of those who were not aware of drug distribution in their communities, 70 (69.3%) were from the Greater Accra region, 19 (18.8%) were from Volta, 11 (10.9%) from Western and the 1(0.5%) from the Upper West region. Greater Accra has smallest proportion of the region being involved in MDA reflecting the challenging nature of urban MDA. This is followed by the Volta region which is non-endemic for LF and with only some of its districts and communities undertaking treatment for onchocerciasis. Western and Upper West regions are endemic for both LF and onchocerciasis and were among the first regions to start undertaking MDA in Ghana. Awareness of MDA in these two regions is therefore expected to be higher than Greater Accra and Volta regions.

During the FGDs and the IDIs, knowledge and awareness of the drug distribution program in the study communities was quite high. Majority of the communities found the distribution channels appropriate and acceptable and testified that the program was of great benefit to them. Some communities however, complained that they were not informed of their children taking part in the drug distribution in schools and would have appreciated that they be made aware of this. Some parents on the other hand were comfortable with their children taking part in the exercise despite rumours that some children lost their lives after taking the drugs on an empty stomach. It was evident during the FGDs that most of the participants or their relations had either used or heard about the drug distribution. Those who had benefited from it testified about the efficacy or effectiveness of the drug. They also stated that after children had been treated for STH, they no longer had frequent episodes of illness as in the past and worm infestation was reduced.

Strategies to improve on information dissemination during the process of MDA are necessary in Greater Accra. Most communities were informed of the drug distribution programme by gong gong beaters, CDDs, radio stations and health workers in the different communities. Of those who had heard of Drug Distribution Programme, 405 (54.8%) said they were informed about the distribution programme by Gong gong beaters, 213 (28.8%) by community volunteers, 110 (14.9%) by health worker and 108 (14.6%) said they were informed through radio stations. Other modes by which they received the information were through neighbour/friends 44 (6.0%), family members 28 (3.8%), and at school 13 (1.8%) (Figure 4.5). High awareness of MDA and its benefits, particularly to children, has been demonstrated by this study, however, public education and prior information given to communities before the exercise if not adequate will adversely affect the MDAs by increasing the refusal rates.

4.12.7 Mode of Distribution

When community members were asked about the mode of distribution of the drugs during the qualitative data collection, majority of the respondents indicated that the chiefs of the various communities are the first persons to be contacted on the arrival of the drugs in the community after which an appropriate time for the distribution could be scheduled. Community members provided several descriptions for the mode of distribution. Some respondents said the drugs were distributed centrally and others said it was shared from house-to-house. Respondents said the drug distribution was a yearly programme and the communities had at the time of the study benefited about six times however, others said the drugs were distributed only once and nothing had been heard of the distribution exercise again. All respondents indicated that heights were measured to determine the quantity of drugs to be given.

People who had taken alcoholic beverages were denied the drugs and advised to come at a time they had taken no alcohol. Some said the drugs were given to the school children under a direct observation treatment (DOT) method supervised by teachers who were given special training on the drug and the distribution exercise. The school children were instructed to report the occurrence of any side effects to their teachers. Various time estimates were given for the last MDA. These varied from less than one month to over 12 months. Many 460 (62.2%) mentioned that it was to prevent/treat elephantiasis, 247 (33.4%) said it was to prevent/treat onchocerciasis, prevent/treat STH, 45 (6.1%) said it was to prevent schistosomiasis and 41 (5.5%) said it was to prevent/treat hydrocele.

Regional disease endemicity seemed to have played a significant role in the response to the purpose of the last MDA (Figure 4.6). Less than a quarter of respondents mentioned other reasons as the purpose of the last drug distribution. These included protecting them from insects; to keep them in good health; to protect them from trachoma and also to protect them from diseases generally. Majority of respondents (24.3%) from Greater Accra mentioned elephantiasis, followed by schistosomiasis and then soil transmitted helminths; the majority (49.9%) from Volta mentioned soil transmitted helminths followed by onchocerciasis and schistosomiasis. In the Upper West region majority (46.3%) mentioned hydrocoeles followed by elephantiasis and then onchocerciasis. In the Western region majority (37.8%) mentioned schistosomiasis, followed by elephantiasis (32.8%) and then onchocerciasis (Figure 4.6).

One important aspect of the study was to determine if communities were aware of the purpose of the mass distribution programmes. During the FGDs and the IDIs almost all community members were aware of the purpose of the MDA however, there were misconceptions as to the type of illness the drugs targeted. While some are of the view that the drugs were for preventing polio in children others are of the view that the drugs are to expel worms from their bodies. Some also think the main purpose of the onchocerciasis drugs was to prevent them from being infected with the disease when bitten by the black flies. Nevertheless, the communities are aware that the drugs for the school children are for expelling intestinal worms, majority of the respondents believed that the drugs are preventive drugs against NTDs, namely trachoma, schistosomiasis, LF and onchocerciasis.

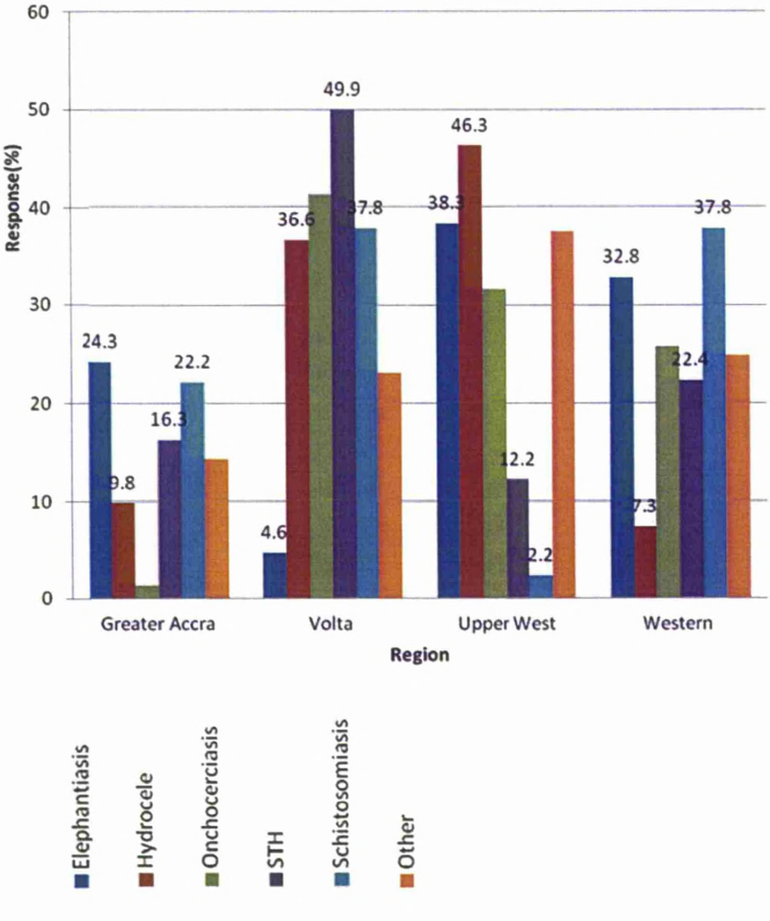
Awareness of the distribution process was also very high. Most of the respondents 555 (75.1%) said the distribution was done from house-to-house, 187 (25.3%) said it was done at a central point from a community centre. Some 38 (5.1%) said it was done from a central point from a school, 14 (1.9%) said it was done from a central point from the chief's palace and 12 (1.6%) said it was done at a central place from the market place. Some respondents mentioned other places including health centres, residence of the community volunteer and central point from the street. Very few of the respondents 4 (0.5%) did not know where the last drug distribution took place.

The number of drug distributions that had taken place in the various communities varied from 1 to 20, however, over 603 (81.6%) mentioned that there had been between 1-5 drug distribution programmes in their community with an average of 3.5 and a mode of 3.

Most respondents 674 (91.2%) who were aware of MDA in their communities said they had taken the drugs administered during the drug distribution exercise. When asked how they felt after taking the drugs, 422 (62.6%) said they felt nothing, 121 (18.0%) said they experienced itching, 96 (14.2%) said they had swellings and 39 (5.8%) said they felt dizzy. Thirty-eight (5.7%) said they felt weak, 13 (1.9%) said they had fever and 9 (1.3%) said they vomited after taking the drug. Other experiences were chills 7 (1.0%), Nausea 7 (1.0%) and various forms of bodily pains 9 (1.2%).

Considerable satisfaction was expressed about either the absence of side effects or the insignificant adverse events of the drugs during the focus group discussions as well as the IDIs. Some perceive the drugs to have no adverse effects, especially when it is given after enough meals and making sure that the right dosage was given. There were a few of the respondents who either experienced or heard rumours of adverse reactions of itching, dizziness, rashes and abdominal discomfort, after taking the drug. Some also said they heard rumours of deaths as a result of taking the drugs though not from their communities.

Figure 4.6: Purpose of Last MDA



This is how some of them put it:

"When we heard the first time that the children were going to be given drugs, some of us went for our children because we heard that some children fell into Coma in some places hence we refused but the subsequent ones we allowed"
Agbesia female group-Volta Region

"I heard that some two children died at Hohoe due to the drugs they took. What I heard was that, the children were given drugs which they did not eat and they died so when our children take it they will die."
Agbesia female group-Volta Region

Some also perceived adverse events as a sign of the drugs being effective

"the drugs are effective because I was feeling dizzy after taking them"
Loggu Upper West

"you hear sounds from your stomach after taking the drugs and this indicates the effectiveness of the drug"
Bulenga-Upper West Region

"it is effective because anytime I take it I become seriously weak and sleep the whole day"
Bonaa-Upper West Region

In spite of the fact that some respondents experienced side effects after taking the drug, 707 (95.7%) of respondents said they would still take the drug anytime it was administered to them. The two most common reasons given as to why they would still take the drug included protection from elephantiasis 521 (70.5) and removal of all forms of disease from their body 82 (11.1%).

Other reasons given were the fact that the disease was common in their communities and also that the drugs produced no adverse reactions. Besides the respondents themselves, 655 (88.6%) said everybody in their household took the drug, 53 (7.2%) said not everyone in their household took the drug and 31 (4.2%) said they did not know if everyone in their household took the drug. The main reasons for people not taking the drugs were for fear of side reactions (40.3%) and 41.8% could not assign reasons why people did not taken the drugs.

The different endemic status of regions and districts determines the drugs administered under mass drug treatment and also the schedule of these treatment programmes which accounts for the knowledge displayed by the different respondents from the different regions on the issues pertaining to the purpose of the distribution exercise and the timing. However, the effect of side reactions on participation, though appearing not to be significant regarding the fact 95.7% of respondents said they would still comply with treatment in spite of experiencing and hearing about possible side effects. Side effects have always been a problem in the implementation of MDA (Dodoo et al, 2007) and often results in many distribution programmes recording low coverage.

4.12.6 Attitude towards Mass Drug Administration

The health benefits of MDA were well appreciated by individuals interviewed. The programme should take advantage of these positive community perceptions to reinforce messages that would enhance the uptake of MDA within communities. The general perception of people towards MDAs was that if some community members refused to take the drugs the diseases will still remain or will spread. During the interviews, 395 (53.5%) said if some community members refused to take the drug, the disease will still remain in the community, and 306 (41.4%) said the disease will spread. However, 110

(14.9%) of respondents said they did not know what the effects will be if some community member refused to take the drugs. Majority of the community members as well as the opinion leaders interviewed were of the view that the drugs are very effective and has reduced the time spent in taking the sick to the health facilities but has also reduced their health spending. They also said that it has reduced delays in seeking treatment for sick children until the illness sometimes worsened when care givers do not have the resources readily available to send their children to the nearest health facilities in the communities. Some are of the view that, after the children have been treated with the drug, they no longer had frequent episodes of diseases as in the past.

Most respondents 472 (63.9%) said nothing will prevent them or their family members from taking the drugs distributed at school or at home once they were eligible for the treatment and had not taken alcohol. Generally comments about the drug treatment were positive except for issues on side reactions. But respondent (99.2%) indicated that negative comments would deter them from taking the drugs (Table 4.4). When asked for their suggestions as to how to improve future MDAs, 315 (42.6%) said there should be more drugs during the distribution exercise, 136 (18.4%) said there should be more announcements before the distribution exercise, 75 (10.1%) said there should be more volunteers during the distribution exercise and 11 (1.5%) said they should be given food before the distribution exercise. Other suggestions included education of community members and forcing everyone in the communities to take the drugs. The challenge of inadequate drugs and logistics had been recognized by many of those interviewed and should influence programmes to ensure proper planning to ensure adequate supply of logistics for the programme. A premium should be placed on a well-planned and executed health education programme as an integral part of programme implementation.

The notion particularly among the women's groups that tablets are not suitable for young children and perceive syrups as the option for children should not be dispelled since it was reported in 2007, 4 deaths of preschool children was recorded in Ethiopia due choking on albendazole tablets. Children groups also are of the view that the tablets should be made smaller to allow ease in swallowing. Though mass treatment does not necessarily target preschool children, the younger children involved should be encouraged to chew the tablets in order to prevent any acute severe adverse reactions associated with swallowing (WHO, 2007).

4.12.9 Community Based Drug Distribution

Community resource persons referred to as Community Drug Distributors (CDDs) with minimal to moderate education are trained as drug distributors to advice and dispense drugs appropriately at community level (WHO, 2012). Either the chiefs or the head teachers of the various schools in the various study communities selected almost all the CDDs. The choice of a distributor for the MDA is dependent on whether the person is already a community health volunteer or a teacher. However, while some opinion leaders are of the view that more CDDs be trained, participants of some FGDs think that teachers who are not indigenes should not be trained as CDDs as they may leave the community after some time or simply because they want other members to be given the opportunity to serve their community. Some are of the view that the distribution should rather be done by health personnel particularly nurses and with that people will be more at ease and attach more importance and seriousness to the exercise because people collect the drugs but refuse taking them.

Majority of community members interviewed were comfortable with the available central point or house-to-house distribution system and particularly with the house-to-house distribution method which made it possible to leave drugs behind or to do revisit treatment for absentees. In order to prevent the spread of communicable diseases such as tuberculosis during the distribution process however, the house-to-house method or individual visits to the distributor were preferred to the central point distribution which promotes crowding of community members associated with the spread of communicable diseases.

"For me gathering at a common point for the drug distribution is not good, because, some people have TB and at a gathering like that, you may contract some disease from other people, I think it is the duty of the CDD to move from house to house because the community is not the large one."
Men Fodome Agbesia Volta Region

"To me it is not good we are gathered in one place but it should be from class to class"
Female child Helu-Volta Region

4.12.10 School Based Drug Distribution

While some parents from the FGDs prevented their children from taking the drug because of the rumours of the death of some school children in nearby communities as a result of taking the drug, most of them were comfortable with their children taking part in the exercise despite rumours that some children died after taking the drugs on an empty stomach. Many (92.8%) of the respondents said MDAs were good for their children. Many (77.5%) of the respondents who had children in school had been told (75.6%) about drug distribution in their schools and had given the consent (99.8%) for the children to participate in the distribution. About 2.8% of respondents said school-based distribution was not acceptable. Based on these findings the IEC/BCC materials should be able to identify and emphasise the specific benefits of mass drug distribution targeted at school-aged children to reinforce the benefits of these distribution programmes.

During the qualitative data collection, majority of the communities found the distribution channels appropriate and acceptable and considered that the program was of great benefit to them. Some communities however, complained that they were not informed of their children taking part in the drug distribution in schools and would have preferred if prior information had been given to them as parents. The strategies of both community-based distribution using community-directed distributors and teachers for distribution of drugs in the school-based distribution programmes, raised some serious concerns about the use of teachers who are non-indigenes. In addition respondents raised the need for more information, especially prior to implementing the distribution programme. Research has however shown that better coverage is obtained with CDDs rather than health workers (Gyapong et al, 2001) as a result the use of indigenes as a distributor is recommended by the CDTI strategy for drug distribution. School-based distribution programmes should also not ignore community education in their implementation since these school children live in communities.

4.12.11 Knowledge of Lymphatic Filariasis

In Ghana, LF is considered a public health problem. With the exception of Volta and Ashanti regions, the other regions of the country are endemic. As part of the objectives of this study, community members' knowledge of was LF was assessed. In all 824 (98.1) of respondents said they had heard of LF a few 16 (1.9%) said they had not heard of the disease. Of those who had not heard of LF 8 (50.0%) were from the Volta region, 4 (25.0%) from the Greater Accra region, 3 (18.8%) from Western region and 1 (6.2%) from the Upper West region. The order of knowledge conforms to endemic status of respondent's regions. Volta region is non-endemic, Greater Accra is partially endemic, Western is mostly endemic while Upper West region is entirely endemic for LF. According to the FGDs, there is no single local name for LF. However community members know the differences between Elephantiasis and hydrocele. Ewes refer to Elephantiasis as "Zibo" and hydrocele as "Evo"; the Gas refer to them as "Nanehela" and "Shinkpamaduru" respectively. The Akans also refer to Elephantiasis as "Ogyampi".

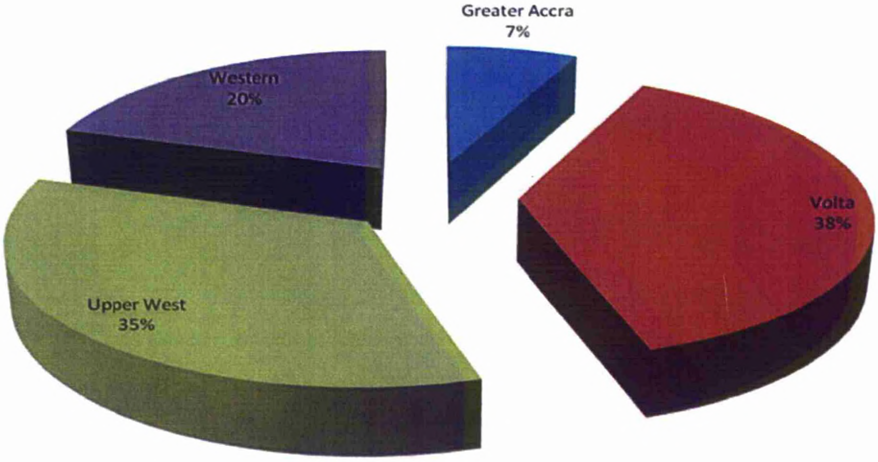
The sources of information on LF varied. CDDs (26.3%), health workers (22.9%), friends and family (22.9%) and radio (25.7%) were the main sources of information. Other minor sources included posters, TV and community events which will require less emphasis during the development of the communication strategies. The most common known symptom by respondents is the enlarged legs and scrotum. In all 803 (97.5%) and 289 (35.1%) mentioned enlarged legs and enlarged scrotum respectively as the signs and symptoms of hydrocele. Besides these two signs, 41(5.0%) mentioned enlarged arms, 11 (1.3%) mentioned painful swollen groin and 11 (1.3%) also mentioned high fever. Four respondents (0.5%) also mentioned enlarged breast as a sign of LF. From the perception of the children's FGD anyone wearing trousers with big bars reaching beyond the ankle (a sign of concealing swollen leg), is identified as having elephantiasis. Community members are also of the view that painful swollen legs with rashes on them are signs of elephantiasis. Concerning people with hydrocele, walking with opened legs because of the enlarged scrotum identifies them.

The presentation of LF was well known, though only 33.7% of respondents indicated that there were people with the disease in their communities. About

97.5% of respondents said it presented as enlarged legs. A smaller proportion of respondents mentioned enlarged scrotum (35.1%), enlarged arms (5.0%) and enlarged breasts (0.5%). Knowledge on the transmission of LF was inadequate as only 6.1% of respondents knowing it was transmitted through the bite of a mosquito. Equally only 55.0% of respondents said taking drugs could prevent LF and 1.2% said it could be prevented by sleeping under mosquito nets.

Most of the individuals affected by the disease were said to have gone to the government or private health facilities (87.0%), 13.6% went to herbalists and 3.0% went to a spiritualist. Treatment administered to patients with elephantiasis and hydrocoeles were generally unknown (49.4%), but 42.0% mentioned tablets while 10.1% mentioned surgery.

Figure 4.7: Knowledge of Lymphatic Filariasis Disease



4.12.12 Attitude toward LF patients

In the communities patients are said to be generally treated with sympathy (37.1%) while 28.3% said people were generally indifferent to these patients. Interestingly, 12.3% of respondents were willing to marry patients with LF while 30.2% were willing to share things with them. Others were willing to share food, clothes, and shoes and make body contact with these patients.

During the FGDs when participants were asked about the causes of LF some mentioned that sores which do not heal can gradually turn into elephantiasis, for example, being pricked by a nail or a concrete product and not taking proper care of the sore. Some were also of the view that when a person's leg gets into contact with cement and is not washed off it causes elephantiasis. There is also the belief that LF is caused by spiritual manipulations

"They said when someone has hydrocele, something might have been placed in the farm for him; so whenever he steps in the farm, he develops hydrocele. They said if a calabash is being carved and it falls you can get hydrocele. If you break a calabash, you'll get hydrocele." Misconceptions about disease transmission especially with regards to LF have been rife since the inception of the programme, however greater efforts need to be put in health education to correct these misconceptions. Information gaps identified by respondents included prevention (37.9%), transmission of *W. bancrofti* (36.0%), treatment (27.3%) and while about 29.4% wanted to know everything about the disease.

As expected few people knew about the management of elephantiasis mainly because this education is targeted at patients with the condition, whose assessment will give better picture of knowledge on the management of patients with lymphoedema. Stigmatisation of patients with LF continues to be an issue that requires dealing with using the IEC/BCC strategies. This should acknowledge physical challenges of LF patients while dwelling on some of the incorrect perceptions of disease transmission.

4.12.13 Knowledge of Onchocerciasis

About 57.7% of all the respondents had heard about onchocerciasis. The source of this information varied from healthworkers (39.8%), radio (29.7%), CDDs (22.1%) and friends and family (18.6%). Other sources of information like posters, community events, community leaders and school events were insignificant. Of those who had heard of onchocerciasis, 185 (38.1%) were from Volta region, 168 (34.6%) were from the UWR, 98 (20.2%) were from western region and 34 (7.0%) were from the GAR (Figure 13).

Figure 4.8: Knowledge of Onchocerciasis

About 44.5% of respondents knew onchocerciasis was acquired through the bite of a blackfly. Others mentioned the mosquito (17.3%), poor hygiene (11.5%) among other modes of acquiring the infection. About 31.3% did not

know how the disease was transmitted. The most predominant presentation of onchocerciasis indicated by respondents was blindness (48.9%), itching (31.8%), and skin rashes (17.3%). Few of the respondents knew about nodules (4.9%), lizard skin (4.3%), and skin depigmentation (1.2%) while 13.2% did not know these onchocerciasis presentations. During the FGDs and IDI's, nodules, itching of the body, painful, itchy and watery eyes that lead to partial and total blindness, was mentioned as symptoms of onchocerciasis, which was generally said to be caused by the bite from flies. However, the cause of trachoma was not explicitly stated. Most (57.1%) of the respondents knew the disease could be prevented by drugs while the others indicated other wrong methods of prevention such as the use of insecticide treated nets, good hygiene and wearing of shoes and protective clothing among others. About 18.8% of respondents did not know.

4.13 Attitude

About 43.1% of respondents knew people in their communities with onchocerciasis. About 27.2% wanted to know about the disease transmission, 31.1% wanted to know about its prevention and 32.2% its treatment. About 37.1% wanted to know about everything while 7.6% wanted to know about the signs and symptoms of onchocerciasis.

4.14 Knowledge of Soil Transmitted Helminthes (Intestinal worms)

In all, 806 (96.0%) of them had heard of intestional worm infestation. Of these, 301 (37.3%) heard it from health workers, 254 (31.5%) heard it on radio, 266 (33.0%) heard it from a friend/family and 127 (15.8%) from a CDD. Other responses included; television, school teachers. Most of the respondents were able to mention at least one means of by which people got infected with intestinal worms apart from 21.7% of respondents who said they did not know. Responses included poor hygiene (37.6%), contaminated water (26.8%), poorly cooked food (26.6%) and contaminated vegetables (15.6%). Other modes of transmission mentioned included sugary foods, poverty, eating seeds and flies. Not wearing shoes was mentioned by only 3.5% of respondents. The mentioned signs and symptoms of worm infestation included nausea and vomiting (71.0%), swollen belly (40.2%), loss of appetite (27.3%), diarrhoea (14.9%), anal and body itching (13.0%), weakness (11.3%) and anaemia (11.8%). Few respondents mentioned fever, headache and fatigue. About 26.7% of respondents said they de-wormed their children every 3 months while 25.8% said they never de-wormed their children. The others dewormed their children once a year (14.5%), once in a while (14.5%), or when the child was sick (8.6%). During FGDs and IDIs, interviewees said a child with swollen belly is seen as potentially having Soil Transmitted Helminths. However, victims may experience abdominal discomfort, nauseous feelings after eating and sometimes vomit after meals, indiscriminate spitting, they have diarrhea, loose appetite and are always lean and weak. They are quick to complain of hunger immediately after meals. Body itching after bathing was also described as a characteristic of intestinal worm infestation. The following quotes depict what respondents had to say:

"A person with worms loses appetite and whenever the person tries to eat he/she feels like vomiting"
Opah Community men

"For Soil Transmitted Helminthes, the person loses weight and become thin and weak if it is a child; he/she will vomit any food taken" Tiisah Men

When respondents were asked what they would want to know with respect to STH (intestinal worms), 278 (34.5%) said they would want to know how one gets worms, 274 (34.0%) said they would want to know everything about the disease. Some 207 (25.7%) said they would want to know about the effects of worm infestation, one third 268 (33.3%) said they would want to know more about the treatment of worm infestation, and 73 (9.7%) said they will want to know about the signs and symptoms.

4.15 Knowledge of Schistosomiasis

In most of the communities, members depend on rivers or ponds as source of drinking water however, most of them agreed that the water bodies polluted with human waste, inflow of waste from gutters during the rains and misuse such as washing and swimming render the water from such sources as unwholesome for human consumption. Some respondents reported that many community members had resorted to drinking 'sachet' water. On how to preserve the quality of the water bodies, many were of the view that activities that caused the pollution must be stopped. In all, 766 (91.2%) of respondents interviewed said they had a river/pond in their community or nearby where they washed (71.4%), swam (45.2%), bathed (43.6%) and fished (29.9%). Some 28.6% of respondents farmed near a river or pond. About 54.3% of respondents indicated that some members of the communities sometimes urinated or defecated into these rivers or ponds. Majority (85.1%) of respondents, however, knew diseases that could be transmitted through water contact and these included schistosomiasis (53.0%), Guinea worm (48.5%), diarrhoeal diseases (23.2%) and typhoid (8.5%). Buruli ulcer and worm infestation were mentioned as other diseases that could be transmitted through water. These streams and rivers were a major source of drinking water for most (48.8%) of the respondents. Another major source was the well or borehole (43.5%), pipe borne water (30.0%) and sachet water (17.5%). Other known sources of drinking water included springs, water tankers and rain water. As many as 91.3% of the respondents had heard about schistosomiasis and knew it was associated with blood in the urine (87.9%)

and painful urination (36.4%). Few mentioned blood in stools (4.0%) or did not know (4%). About 51.5% of respondents said one could become infected by swimming in rivers or ponds, drinking contaminated water (27.4%), bathing in rivers or ponds (26.6%) or eating contaminated food (8.0%). Some 21.0% of respondents did not know.

Focus group discussion participants also demonstrated that, recognition of schistosomiasis is determined by specific signs and actions exhibited by victims rather than just the mere sight of the victims while some observations are that victims experienced blood in urine, in others the bloody urination was accompanied by pain in the groin and lower abdomen. A few respondents mentioned bloody stools and diarrhoea as signs of schistosomiasis.

"Actually schisto, 'Wudordor" you wouldn't be able to tell unless the person tells you, or you see the person urinating".

Focus group discussion participants are aware of schistosomiasis and while some of them are of the view that the schistosomiasis is caused by working long hours under the scorching sun, others think drinking dirty water causes it. Overall there seems to be good knowledge that, schistosomiasis is a water borne disease. In some communities schistosomiasis is seen as affecting children rather than adults and it is as a result of the children bathing in contaminated water bodies and stagnant waters.

"Long hours of working in the sun causes me to urinate blood"
Man Kojo Ashong

When respondents were asked what measures could be taken to protect people from contracting the disease, 408 (53.2%) said one should avoid swimming in rivers and ponds, 209 (27.2%) said taking drugs could protect one from the disease, 205 (26.7%) mentioned avoiding bathing in rivers/ponds, 92 (12.0%) mentioned avoiding washing in the rivers and ponds and 33 (4.3%) said avoiding wading in rivers and ponds. Other responses included health education, provision of safe drinking water and practicing good hygiene.

When asked what measures community members felt should be taken to prevent contamination of water bodies, 387 (46.1%) said people should not urinate, 369 (43.9%) or should not defecate in water bodies, 279 (33.2%), reported potable water should be provided and 140 (16.7%) said communities should be provided with toilet facilities, 105 (12.5%) and sewage disposal facilities. Other responses included fencing off water bodies, health education and treatment of the water source.

When respondents were asked what they would want to know with respect to schistosomiasis, 340 (40.5%) said they would want to know how one gets worms, 313 (37.3%) would want to know how it's treated, 272 (32.4%) said how one can contract the disease, 170 (20.2%) said they would want to know the effects of the disease and 66 (7.9%) said they would want to know the signs and symptoms.

4.16 Available and Preferred Channels of Communication

Out of the total number of 840 households heads interviewed most felt that community members should be informed of drug distribution exercises through gong gong beaters 388 (46.6%) which are local drummers who beat the drums to attract attention for community announcements, health workers 235 (28.0%), radio announcements 190 (22.6%) and through the national information service 98 (11.7%). In Greater Accra, 107 (51%) answered gong gong beaters, 78 (37.1%) said information service, 49 (23.3%) radio, and 24 (11.4%) answered television. In the Volta region respondents felt that community members should be informed of these exercises through chiefs

106 (50.0%), gong gong beaters 100 (47.6%), and health workers 61(29.0%). Only 13 (6.2%) of respondents in the Volta region mentioned any form of mass media. In the Upper West community members wanted to be informed of MDA activities by health workers 101 (48.0%), gong gong beaters 43 (20.5%), chiefs 37 (17.6%), and radio 29 (13.8%). In the Western region respondents felt that community members should be informed of MDA activities through gong gong beaters 138 (65.7%), Radio 99 (47.1%), Health Workers 67 (31.9%), and chiefs 44 (21.0%). As a mode of communicating these health education messages, the majority 600 (71%) of the respondents mentioned health talks. Other significant forms mentioned included community durbars 193 (23.0%), radio 166 (19.8%), drama or theatre 91 (10.8%), posters 66 (7.9%), and television 48 (5.7%). At the regional level, the health talk remains the most listed response for desired form or potential format of health education messages: Greater Accra 102 (48.6%); Volta 177 (84.3%); Upper West 149 (71.0%); Western 172 (81.0%). Although it is still the highest response, it is worth noting that under 50% of respondents listed health talks in the Greater Accra region, while over three quarters of respondents in the other three regions listed health talks. Community durbars were an important form in which people would like to receive health messages in the Volta region 51 (24.3%) and Greater Accra 69 (32.9%), while radio was an important method of sending health messages to respondents in the Upper West 51 (24.3%) and the Western region 60 (29.0%).

Health education preference was distinctly different among peri-urban and rural dwellers when the views of community members were sought during the FGDs and IDIs. While in the peri-urban community education on radio and television during talk shows and posters were their preferred sources of health education. The first option for rural dwellers is by beating the gong-gong under the direction of the community chief. Interpersonal communication seems to be another option for rural dwellers compared with urban dwellers.

Rural dwellers were also of the view that educational messages be presented in a drama form where the actors should be people from outside their communities. Others wanted the education on market days since women, who are predominantly care givers sell their produce and wares on market days. Others want some of the drugs to be given on the day the talk is given. Urban dwellers wanted the education on the drugs on radio and in the evenings when most people would have returned from work. They asked that adverts are made on the local FM station in the mornings before work or in the evenings after work. Overall fifty percent of respondents interviewed stated that village and community meetings were their preferred locations for health information to be distributed. This remained consistent in three of the four regions. In Greater Accra, community members preferred health information to be given at home 80 (38.1%) and in schools 77 (36.7%). There is no significant difference between preferred locations for men and women.

The study revealed that overall religious gatherings 43 (51.7%) followed by women's groups 216 (25.7%), and men's groups 177 (21.1%) are the most listed types of events in the communities (Table 4.20). However, there are some distinct regional differences that should be noted. In the Greater Accra and the Volta regions religious gatherings remained the most important form of social gathering listed with Greater Accra, 131 (30.2%) and Volta 167 (35.8%) respectively. However, in the Upper West region women's group gatherings are reported by a much higher percentage of people at 131 (62.4%) followed by men's group gatherings at 109 (51.9%). In the Upper West region 37 (8.5%) of respondents listed religious gatherings. When asked where community members go for entertainment Community centres 221 (26.3%), drinking spots 189 (22.5%) and parks 183 (21.8%) were the most frequented locations.

Table 4.20: Types of Meetings that take Place in Study Communities

	Yes	
Response n=840	Freq	%
Religious gathering	43	51.7
Political gathering	89	10.6
Women's group	216	25.7
Men's group	177	21.1
Work association	115	13.7
Other, specify	288	34.3

In Greater Accra drinking spots are the most reported location for entertainment 109 (51.9%). For all communities, 523 (62.3%) mentioned the community chief as the most important person to contact with important information. Other important points of first contact listed were Assembly men/women 96 (11.4%) and community elders 91 (10.8%). Although community volunteers were only 51 (6.1%) it is interesting to note that community members listed community based volunteers higher than health workers 27 (3.2%) Respondents in the Upper West listed community based volunteers as the second most important person to contact with important information at 36 (17.1%). However respondents said that normally they would go to see a health worker for information or advice on health 438 (52.1%). Family members and spouses were also an important source of information for respondents on health issues (Table 4.21).

Table 4.21: Sources of Information

	Yes	
Response n=840	**Frequency (N)**	**Percentage (%)**
Friends	66	7.9

Family member/relative	223	26.5
Spouse (husband/wife)	145	17.3
Teacher	10	1.2
Health worker	438	52.1
Other, specify	129	15.4

4.17 CROSS-SECTIONAL COMBINED KNOWLEDGE, ATTITUDE AND PRACTICE , COVERAGE AND COMPLIANCE HOUSEHOLD ASSESSMENTS

4.17.1: Introduction

Cross-sectional quantitative exploratory surveys were conducted as part of assessments of the epidemiology and control of LF in Ghana. These surveys were undertaken in the first 5 start up districts of the programme and included epidemiological and coverage assessments. Parasitological surveys were conducted on blood collected from among the adult populations and antigen and antibody filter paper assays conducted on blood collected from children from 0-5 years were used to assess the impact of MDA on the first 5 start up districts all of which had completed the minimum of 6 rounds of MDA using ivermectin and albendazole under the LF Elimination Programme in Ghana. Combined KAP coverage reliability and compliance assessment surveys were conducted as part of these cross-sectional surveys. Finally an assessment of the morbidity control programme for cases of elephantiasis and hydrocoele were carried out employing designed quantitative assessment surveys for both identified patients and other community members.

4.17.2: Method of Combined KAP, Coverage and Compliance Assessment

Quantitative surveys for the household heads employed the 30-cluster sampling method for household selection. For each of the 5 districts 30 communities were randomly selected from a list of all its communities without taking into consideration the sub-district demarcations. From each of the selected communities 10 compounds or houses were randomly selected from each of the communities. This was done by spinning a pen and the trained data collectors assigned in different directions determined by the pointer of the pen. If the pen pointed in a particular direction more than once the pen was span again until a new direction determined by the pointer was found. In each identified house or compound the first identified household was selected and interviewed, therefore only one household was interviewed for each compound visited. In each household the household head or his representative was interviewed for the first part of the survey for the KAP assessment.

4.17.3: Results and Discussions on Combined KAP, Coverage and Compliance Assessment

A total of 1508 household heads were interviewed from 28 sub-districts. The number of household interviewed in each sub-district varied from 10 to 148. The proportions of household heads interviewed were equal for all the 5 study districts. The proportion of males interviewed as household heads represented 50.7% while women formed 49.3%. Most household heads (74.9%) were married with 25% being either single (9%), divorced (6%) or widowed (10%). Household sizes varied from 1 to 20. Households with sizes with up to 5 people formed 72.5%, followed by those between 6-10 (25.4%), then those from 11-15 (1.9%) and then those greater than 15 (0.1%) (Figure 4.22). Households with a size of 4 formed the greatest proportion of 21.8%, then 3 with 18.4% followed by 5 with 17.5% however, the average household size in Ghana, which is five (GDHS, 2000).

Table 4.22: Household sizes for Compliance Survey

Household Size (N)	Frequency N)	Percent (%)
<5	1094	72.5%
6 - 10	383	25.4%
11 - 15	29	1.9%
>15	2	0.1%
TOTAL	1508	100%

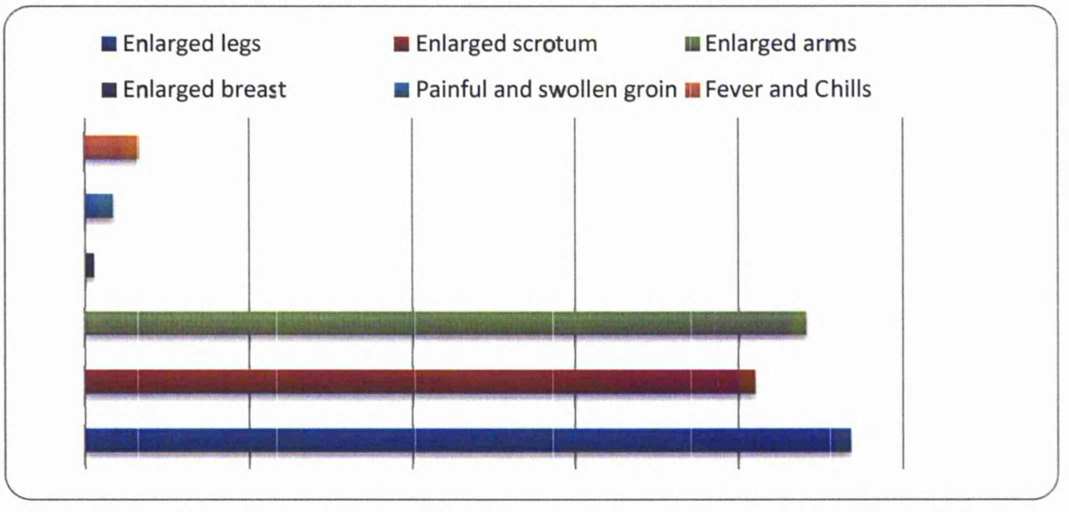


Figure 4.9: Symptoms of Lymphatic Filariasis

Almost all the respondents (99.4%) knew about elephantiasis, the common name for LF. For the symptoms of LF, majority (93.6%) of the respondents knew it affected the limbs, while 88.1% said it also affected the arms, and 82.0% also said it could affect the scrotum as well. Very few of the respondents knew it could affect the groin (3.3%), the breast (1.0%) or have the symptoms of fever and chills (6.6%) (Figure 4.9).

On the mode of transmission of infection, only 31.8% of respondents knew the mosquito could transmit the disease, 10.1% said the disease could be acquired through contaminated food while 27.2% said it could be acquired through contaminated water. With regards to the causative organism for the disease, 35.3% agreed worms were responsible for the disease, 1.4% said it was viruses while 3.6% said bacteria were responsible. Knowledge about the disease transmission was highly inadequate making it difficult to influence any behaviour change that will be required to improve compliance with treatment and control of the disease. However, information on disease causation and transmission though provided as part of public health education prior to the MDAs, the understanding of community members was limited considering the level of education particularly in rural communities.

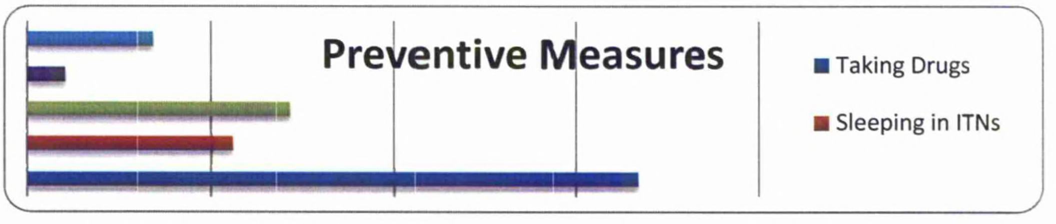


Figure 4.10: Available Preventive Measures

In response to how to prevent LF, 66.7% of interviewees indicated that drug treatment, then 28.6% said keeping the environment clean could help prevent the condition while sleeping under insecticide treated nets accounted for 22.3% of responses (Fiugre 4.10). About 98.5% of respondents were aware of MDA for LF in their communities, but 91.5% of them were able to indicate that 2 different drugs were administered during this exercise. Only 59.4% of household heads were aware that children below a certain height could not take the drugs, 74.5% were aware that pregnant women were not eligible for the treatment, 14.0% knew some breastfeeding mothers could not take the drugs, and 15.7% knew that seriously sick people were not supposed to take the drugs.

About 64.6% of household heads indicated that everyone in their household had taken the drugs, while 78.1% were aware of possible side effects of taking the drugs but only 36.9% were able to name some of these side effects which included rashes (25.4%), swelling of certain parts of the body (16,2%), headache (24.3%), fever (19.8%) and chills (5.4%). Inspite of the possible side reactions 92.7% of the respondents said they would continue to participate in the MDA if the drugs were given again, however in terms of the number of times they had participated in the MDAs, though all these 5 districts had undertaken MDAs over a minimum of 6 annual rounds, only 30% of household head respondents had taken the drugs 6 times. About 58.8% of household heads interviewed knew someone with elephantiasis or a hydrocoele while only 10.1% of households interviewed had a hydrocoele or elephantiasis patient present in that household. Only 26.8% of respondents were aware of the availability of treatment for patients with hydrocoele or elephantiasis. It should be noted that most cases of elephantiasis are irreversible which is a well-known fact shared with communities as part of health education inspite of the fact that hydrocoeles are treatable.

4.17.4: Compliance with Treatment

Generally compliance with treatment improved from year 1 to year 6 in all the 5 start up districts of the programme. The ineligible population comprising of individuals of <90cm, the pregnant, severely sick and breastfeeding mothers with children less than a week old, did not show any significant difference in trends from year 1 to year 6 (Table 4.23). The absentee population however showed a downward trend from year 1 to year 6 with a reduction in the incidence of side reactions also from year 1 to year 6 (Table 4.23).

Table 4.23: Reasons for Non-compliance

Year of MDA	Surveyed Coverage (%)	<90cm	Pregnant	Severely Ill	Breast-feeding	Absent	No Side Effects	Side Effects
Year 1	25.9	5.8	0.5	0.8		39.4	22.9	0.2-0.5
Year 2	30.4	6.2	0.5	0.8	0.3	36.8	22.6	0.2-0.4
Year 3	39.5	6.9	0.6	0.8	0.2	31.7	36.6	0.2-0.7
Year 4	56.4	7.7	0.6	0.8	0.2	20.9	51.8	0.3-0.9

Year 5	68.1	8.2	0.6	0.6	0.1	15.1	63.4	0.4-0.7
Year 6	71.9	7.6	0.5	0.5		12.7	67.2	0.3-0.9

Table 4.24: District Compliance from Year 1 to Year 6

District	Frequency (N)	Year 1 (%)	Year 2 (%)	Year 3 (%)	Year 4 (%)	Year 5 (%)	Year 6 (%)
Sissala	1154	31.5	33.2	38	47.2	60.5	64
Kassena Nankana	1321	13.6	18.5	32.1	57.3	71.1	75
Builsa	1582	39.3	47.8	58.8	77.4	83.8	85.9
Awutu Efutu Senya	1259	14.9	18.7	24.8	45.7	61.6	67.8
Ahanta West	1460	26.9	29.8	24.8	50.3	60.3	62.6
Total	6776	25.9	30.4	39.5	56.4	68.1	71.9

Figure 4.11: MDA Compliance from Year 1 to Year 6

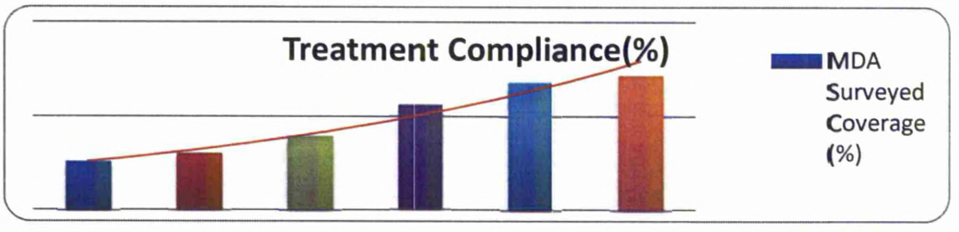
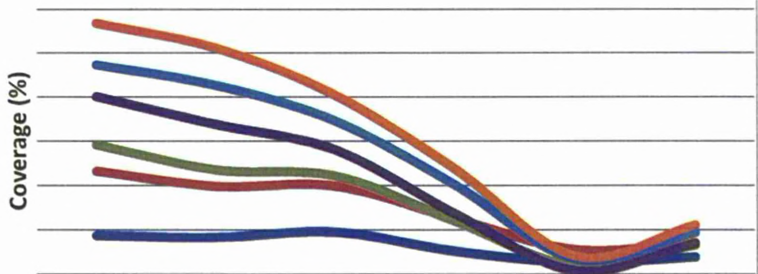


Figure 4.12: MDA Compliance from Year 1 to Year 6 by District

Figure 4.13: Differences between Reported and Surveyed

Difference between Reported and Surveyed Coverage over 6 Years in Start Up District



	year 1	year 2	year 3	year 4	year 5	year 6
Total	48.0	42.4	29.4	18.3	3.0	8.7
Sissala	35.7	43.9	32.5	32.3	13.0	12.0
KND	54.6	51.6	29.7	8.5	-5.1	2.0
Builsa	29.5	18.5	11.3	-3.1	-18.8	-2.9
Awutu Efutu Senya	72.8	57.8	51.9	36.7	14.3	16.4
Ahanta West	43.3	41.0	47.3	25.6	13.1	19.0

4.17.5 Coverage

Compliance showed an exponential increase from year 1 to year 6 for all five districts together and also for the individual districts (Figure 4.11). The differences between the reported and surveyed coverage each of the surveyed districts also showed reductions in trends from year 1 to year 6. Determination of treatment compliance through the questionnaire was undertaken for all household members by interview. Results obtained showed improved trends from Year 1 to Year 6 exponentially all the 5 districts and for the aggregated data for all the districts. In Year 1 treatment coverage for all the 5 districts increased from 25.9% to 30.4% in Year 2, then to 39.% in Year 3, 56.4% in Year 4, 68.1% in Year 5 and finally 71.9% in Year 6 (Figures 4.11 and 4.12). Individually each of the districts also showed similar trends in compliance from Year 1 to Year 6. There was however, a slight increase from year 5 to year 6. This observation was also made for all the 5 start up districts.

From the inception of the programme in year 1 to year 6, the there was a gradual up-scaling of the programme with lessons learnt being applied to improve on programme delivery in subsequent years. The proportion of the ineligible population however is not expected to change much since the programme is not expected to have any effect on these indicators. However as the worm load in the communities reduced with treatments undertaken, the incidence of severe adverse reactions is expected to reduce significantly as was observed.

As expected, treatment compliance improved as the programme delivery improved. Knowledge attitudes and beliefs of LF also improved. However the observed increase in the difference between reported and surveyed coverage due to reduced compliance from year 5 to year 6 could be due to the introduction of the integrated preventive chemotherapy programme which included other programmes like onchocerciasis, soil transmitted helminths, schistosomiasis, trachoma and LF. Since this was a new programme involving different implementation strategies the programme delivery suffered and this reflected in reductions in coverage and compliance. The timing of the funding for this activity was also delayed to the rainy season when farming activities interfered with the drug distribution programme with observed reduced coverage.

4.17 Conclusion

NTDs are one of the worst conditions in terms of their deforming, stigmatizing nature and long term sequelae. However, little attention is given to the control of these diseases. Generally, there is little awareness of the four NTDs studied. This is a clear indication that the population are largely unaware of the causes and are most likely unaware of the prevention.

On the whole, there is a high level of acceptance of drug distribution in schools. There is also high level of awareness of MDAs. However the process is characterized by poor communication on the drug distribution exercise to parents and the general public. The high level of acceptance is not based on an understanding of the purpose of the drug distribution exercise but because it emanates from the Ghana Health Service. Despite the high acceptance rate, most people did not know the purpose of the exercise.

Despite the fear of side effects, there was still high level of acceptance. However, there is the likelihood of a high level of drop-out as people are concerned after hearing of the negative comments. For now the spread of negative comments has been minimal but if a conscious effort is not made to educate the general public, coverage for the NDA would be greatly affected. There is great awareness of the importance of the whole community taking the drug as respondents were aware of the fact that if some community members do not take the drugs, the disease will still remain and possibly spread in the communities. Notwithstanding the high level of acceptance of MDAs, lack of education and communication on the distribution means that some people do not take the drug. In the Upper West region, some people refused to take the drugs because they could not abstain from alcohol prior to the taking the drug. There were also general incidences of refusal as a result of fear.

There are very distinct regional differences on how people felt communities should be informed about drug distribution exercises. Overall gong gong beaters were the preferred method of disseminating information about drug distribution exercises in the communities. Religious gatherings could be an effective way of communicating to community members about MDAs. Chiefs are an important channel to effective implementation of health programmes in the various communities.

Generally, the electronic mass media is a preferred choice of communication for people in the Greater Accra and Western regions. Information services are most appreciated in Accra. Although the cell phone remained statistically insignificant (1%) it is interesting to note that persons who responded to this came from the two most rural areas (i.e. Volta and Upper West regions).

4.18 Recommendations

Results from the study demonstrate that people are less interested in knowing the signs and symptoms of NTDs, thus developing educational materials should focus on treatment and prevention rather than the signs and symptoms. Chiefs are an important channel for the implementation of preventive chemotherapy programmes, they should therefore be part of research that focuses on community directed interventions. There is the need for the development of an effective behaviour change communication (BCC) tool because the results showed that people's knowledge on the causes of these diseases did not influence their lifestyle.

There has been a significant amount of education that the medicines distributed are equally good for children, but there is still the notion, particularly among the women's groups, that tablets are not suitable for the young children; they suggested that children be given syrup. Some of the children's group also suggested the drugs be made smaller for them. It may not be possible for the programme to address such concerns but the programme should publish and provide such information to partners who are able to influence decisions on the formulation of drugs used for such programmes as they eventually improve compliance.

The LF Elimination Programme as a disease specific programme has demonstrated improvements in knowledge on the disease and its transmission and prevention. Positive attitudes and practices of LF was demonstrated by improvements in compliance from year one to year six and the willingness of communities to continue to comply with subsequent treatments. Anticipated challenges associated with community fatigue after several years of MDAs and issues of urban MDA would require that these challenges including that of integration with other preventive chemotherapy diseases would require new, innovative and effective advocacy, behavioural change communication strategy to improve programme visibility and its acceptability to both rural and urban communities while soliciting local government support to the integrated programme.

Chapter 5

Assessment of Clinical Manifestations of Bancroftian Filariasis in Selected Districts

Chapter 5: Assessment of Clinical Manifestations of Bancroftian Filariasis in Selected District

5.1 Background

Hydrocoeles and lymphoedema often known as elephantiasis of the limbs are major clinical disabilities that occur as a result of infection with *W.bancrofti* and are the commonest clinical presentations of LF disease. (Dreyer et al, 2000). The disease LF can be found among individuals of all ages, sexes and but particularly among those of low socioeconomic status (Dreyer et al. 2000). The clinical spectrum of the disease is wide beginning with the infected but symptomless carriers, through to those with the disease and who are microfilariamia positive, to those with chronic manifestations of the disease (Dreyer et al. 2000). There are significantly more infected people in a given population than those with chronic disease manifestations. Therefore only a small fraction of those infected proceed to develop the chronic disease (Addiss et al, 1995; Gyapong et al., 1998; Lammie et al, 1994).

5.2 Ghana's Situation

Pre-independence health reports indicated the presence of elephantiasis in Ghana (cited by Gyapong et al, 1996 from Department of Health, 1936-1937). Other clinical reports indicated that elephantiasis and hydrocoeles were common in the early 1990s (Gyapong et al, 1996). A population survey indicated that 12.6% of compounds visited in Northern Ghana had at least one resident with visible or reported elephantiasis of the leg (Gyapong et al, 1995).

Hospital records showed that hydrocoelectomies accounted for 20% of surgeries undertaken in district hospitals (Gyapong et al, 1994). Microfilaria prevalence was found to be 41% in these populations (Gyapong et al, 1993,1994). The press reported an outbreak of elephantiasis also in 1990s (Gyapong et al, 1996). Prevalence of reported elephantiasis is 0.6% (range 0.0-11.8%) and that of hydrocoeles is 5.5% (range 0.0-19.5%). The average cost of hydrocoelectomies was more than a months' income of the average worker in Ghana (Gyapong et al, 1996).

5.3 Global Programme

The World Health Organization (WHO) launched the GPELF in 2000. Since then progress in scaling up MDA has been good (WHO, 2009) with impressive health benefits (Ottesen et al, 2008) but morbidity management has generally lagged behind despite excellent national programmes (Brantus 2009; Suma et al 2002; Mathieu et al 2008). Chronic manifestations of LF make it the second leading cause of disability with an estimated 40 million people affected by the disease (Zeldenryk et al, 2011). It causes physical debilitation, social stigmatization, and economic loses (WHO, 1995) which makes participation in daily community activities difficult (Zeldenryk et al, 2011).

The GAELF and the participating countries should devote more attention to morbidity control activities to address the physical suffering of affected individuals with the added complex psychosocial issues that affected individuals face (Zeldenryk et al, 2011) has been emphasised. Interruption of transmission alone has no short-term effect on the prevalence or incidence of chronic disease, particularly elephantiasis of the leg and advanced uro-genital disease (Fan et al, 1995). Addressing the needs of those already affected enhances community acceptance of measures to interrupt transmission. Other factors worsening the negative effects of lymphoedema-related stigma are poverty, poor access to health care resources and limited education, poor social support affect, the coping strategies of affected women and the negative effects of lymphoedema related stigma (Person et al, 2009).

The present strategies of the GAELF focuses on research, training and integration of lymphoedema management into the health system (WHO, 2010b) instead of the proposed reporting of number of people trained in lymphoedema management. Additionally however, lymphoedema management, number of hydrocoele surgeries performed and number of lymphoedema patients treated, the number of cases who are actively maintaining self care activities, number of cases who have seen a reduction in ADL attacks or the number of patients with new disability or with reduced limb swelling due to lymphoedema on the other hand provides better information for public health monitoring (Kumari et al, 2007) and decision making. The number of support groups instituted, involvement in income generation activities and patients returning to work or school (Zeldenryk et al, 2011) could also be applied to measure the impact.

5.4 Pathology and Pathogenesis of Lymphatic Filariasis Disease

The main, obvious and most common clinical manifestations of LF are hydrocoele and lymphoedema (Dreyer et al, 2000). In filariasis endemic areas infection with *W.bancrofti* may be responsible for the development of lymphoedema and hydrocoeles, however this chronic presentation of the disease may be found in a minute fraction of the population (Addiss et al, 1995, Gyapong et al, 1998; Lammie et al, 1994; Sahoo et al, 2000.). Evidence in support of filarial worms being the causative agents of the disease has been provided by ultrasound findings by locating the living adult worms in intra-scrotal lymphatics (Dreyer et al, 2000). Death of the macrofilaria has been found to trigger off acute clinical manifestations in both hydrocoele and lymphoedema cases. An uncomplicated acute filarial lymphangitis is common in endemic areas but does not necessarily lead to acute lymphoedema (Dreyer et al, 2000).

Little is understood of the pathogenesis of the chronic disease, however inflammatory process mediated by the host immunity, secondary bacterial infections and genetic predisposition seem to play a role in the development of elephantiasis and hydrocoeles (Pfarr et al, 2009). The disease may be classified into the 'acute inflammatory' and 'chronic obstructive syndromes', which do not necessarily have the same pathogenesis (Chan et al, 1998). The differences in the outcome of these chronic diseases in different individuals are attributable to different immunological responsiveness to the filariasis parasites in endemic populations with some amount of genetic regulation taking place (Bouma et al, 2003). The role of host genetic factors in the development of either elephantiasis or hydrocoele is not yet established (Panda et al, 2011). The role of *Wolbachia* bacteria, rather than the filarial nematode in filarial disease and the use of the antibiotic doxycline have gained more importance with recent studies in the management of LF (Lammie et al, 2002; Taylor, 2003; Taylor et al, 2005; Hoerauf 2005). The pathological changes that occur within the skin of patients with lymphoedema include the lymphocyte and monocyte accumulation, endothelial cell activation, lymphatic dilatation and fibrosis with modification of connective tissue in the long-term (Dreyer, et al. 1999, 2000). Formation of the granulomatous nodule, which impedes lymphatic flow, predisposes the affected individual to secondary bacterial infections leading to fibrosis, lymphatic obstruction and finally lymphoedema (Pfarr et al, 2009).

Other manifestations of LF include chyluria, chylocoeles and lymph scrotum. Chyluria results when dilated lymphatics leak fluid into affected sites or drain the fluid through an existing channel such as the urinary tract. Chyocoele results when this fluid accumulates within an organ. These disease manifestations have been strongly associated with bancroftian filariasis in endemic areas (Dreyer et al, 2000).

The spectrum of clinical presentations of LF includes sub-clinical lymphangiectasia and acute filarial lymphangitis (AFL) (Dreyer et al, 2000). Infected individuals who carry the adult worms may experience dilatation of the lymphatics due to immune reactions between the host's and the adult worms (Dreyer et al, 1996; Dreyer et al, 1996; Norões et al, 1996; Norões et al, 1997; Dreyer et al, 1999; Amaral et al, 1999). Subclinical lymphangiectasia does not result in obstruction of the lymphatics. The death of the adult worm ends this inflammatory reaction with the formation of a granulomatous nodule, which is detected when physical examination of the scrotal region is carried out (Dreyer et al, 1996; Norões et al 1996; Norões et al 1997; Amaral et al 1999; Dreyer et al 1999).

Hydrocele, chyluria, chylocele and lymph scrotum develop as a result of the presence of the adult worm, lymphangiectasia, location of adult worm nests and the sequence of the adult worm death (Dreyer et al, 2000). Lymphangiectasia and inflammatory reactions are different components of the lymphatic pathology that result from adult worms toxins and immune reactions to the damaged or dead worms (Norões et al, 1997; Dreyer et al, 1998). Lymphangiectasia may be present in all individuals who harbor living adult worms but can remain subclinical for undetermined periods of time, or evolve into chronic disease. (Dreyer et al, 2000) Death of the adult worms is associated with episodes of acute lymphangitis (AFL) or may be sub-clinical with no complaints from affected patients. However predisposition to secondary bacterial infections may be found with lymphangiectasia in the skin of the upper and lower limbs, breasts, scrotum and penis. Recurrent bacterial infections promote the progression of lymphscrotum to scrotal lymphoedema and elephantiasis (Dreyer et al, 2000).

The disease may be difficult to diagnose the reasons being that not all individuals with the disease have an active infection and also not all those with the clinical presentation may be infected with LF (Dreyer et al, 2000). Finally, similar clinical presentations do not necessarily follow the same pathogenesis (Dreyer et al, 2000). The fact that filarial worms are a cause of pathology is supported by ultrasound findings of living adult worms in the intrascrotal lymphatics (Dreyer et al, 2000). The dying adult worms were also found to trigger the acute disease in cases of hydrocoeles and lymphoedema (Dreyer et al, 2000).

Podoconiosis, non-filarial elephantiasis as a differential is diagnosed based location, history, clinical findings and the absence of microfilaria or antigen on laboratory diagnosis (Davey, 2010; Tomczyk, 2012). It is another of the NTDs found in tropical Africa, central and south America and northern part of India. Podoconiosis is chronic, non-infectious and results in below-knee swelling of the legs among those who live and walk bare-footed on red clayey soil. The disease often develops before the fourth decade of life. Many of the affected became bed-ridden because of frequent acute attacks (Davey, 2010; Alemu et al, 2011; Tomczyk, 2012). Podoconiosis is another disease of farmers, uneducated, and poor. It is more prevalent among females than males, imposes a huge burden in affected communities and countries and often requires similar interventions as with filarial elephantiasis to prevent, treat and control the disease apart from drug treatment. Prevention and treatment is mainly by the wearing of shoes and foot hygiene (Davey, 2010; Alemu et al, 2011; Tomczyk, 2012).

5.5 Morbidity Management in Bancroftian Filariasis

An estimated 29 million men have urogenital manifestations of LF, including hydrocele, chylocele, and lymphedema and elephantiasis of the scrotum and penis. Hydrocele can be successfully treated with simple surgery depending on the resources and infrastructure available. Similar to the legs, the skin of the scrotal wall and penis are prone to secondary bacterial infections and acute attacks (Dreyer et al, 2000). Basic hygiene can stop the acute attacks in the genital area and improve the patient's condition, although the definitive solution for advanced lymphoedema and elephantiasis of the genitals remains a challenge (Seim et al, 1999).

Presently the main strategy for the control of LF is MDA to identified endemic communities with different drug combinations of ivermectin and albendazole or DEC and albendazole depending on the causative parasite responsible for the disease in these locations (Ottesen, et al, 1997). These medicines are able to prevent transmission of *W.bancrofti* and thus provide protection for generations against the disease in endemic areas (Ottesen et al, 1997). However, these medicines are not able to prevent morbidity in those who are currently at-risk of developing the disease irrespective of the person's history of infection. The role of bacterial super-infections in the development of lymphoedema and its progression to elephantiasis is important. Morbidity management, which relies on effective strategies to control secondary bacterial infections in order to achieve the best disease prevention at the community level, is presently available. Hydrocoele repair also helps to reduce sexual disability associated with bancroftian filariasis (Dreyeret al, 1997).

Alleviating the suffering of individuals affected with morbidity due to LF has been found to have marked impacts in affected individuals and communities at large. Measuring the impacts of morbidity management presents a challenge in the absence of clear indicators for making this determination.

Improvements in the physical and socio-economic well being of those affected have the ability to present a clear picture of effective morbidity management strategies for LF.

Though the development of LF is unclear recurrent episodes of acute lymphangitis does constitute a major risk factor in the development of chronic lymphoedema and elephantiasis (Dreyer et al, 1999). LF causes significant disability related to the intensity and frequency of episodes of ADL (ADL) (Pani et al, 1995; Shenoy et al, 1995; Dreyer et al, 1999 ;). The relationship between the number of ADL attacks and the grade of edema is established (Shenoy et al, 1995) and frequency of ADL episodes is directly associated with the progression of lymphoedema characterized grades of lymphoedema (Pani et al, 1995; Shenoy et al, 1995; Dreyer et al, 1999;).

ADL is an important clinical manifestation of the infection. Its recurrence has led to the progression of the disease and also has important socioeconomic implication since they cause significant loss of person day's work (Shenoy et al, 1995). Two distinct disorders accompany lymphangitis in LF endemic areas (Dreyer et al, 1999). Acute filariasis lymphangitis (AFL) is caused by the death of the adult worm, often asymptomatic or with a mild clinical course and rarely causes residual lymphoedema. The other which is acute dermatolymphadenitis (ADLA) is not caused by the filarial worms but often results from secondary bacterial infections and is the common cause of lymphoedema and elephantiasis (Dreyer et al, 1999).

The socioeconomic effect of ADLs is the loss of days of work (Shenoy et al, 1995) but basic lymphedema management has the advantage of reducing ADLA frequency (Addiss et al, 2010). Lymphatic damage related to the adult worm results in increased susceptibility to these repeated bacterial infections, which lead to progression of lymphedema and elephantiasis. The central core of lymphoedema treatment is the prevention of these acute attacks through basic hygiene using soap and water, and through cure and prevention of small skin lesions with application of topical antifungal and antibiotic cream. This approach is feasible at the community level and it can prevent acute attacks, thereby preventing lymphoedema progression as well as causing a certain degree of regression, even in advanced cases (Seim et al, 1999).

The clinical spectrum of disease is documented and includes people who are micro-filaraemia positive but without symptoms of the disease as well as those with symptoms of the disease. The GAELF emphasizes the need to combine transmission control and morbidity management mainly foot care aimed at prevention of secondary bacterial infections (Suma et al, 2002). Effective but inexpensive sustainable treatment for lymphoedema of the extremities is available. The vast majority of acute attacks or lymphangitis in filariasis-endemic areas are caused not by the filarial parasite but by secondary bacterial infections (Montestruc et al, 1960; Dreyer et al, 1997; Shenoy et al, 1995; Olszewski L et al, 1997;).

Lymphoedema management has been identified to improve MDA coverage and accelerate interruption of transmission and this has become crucial to the success or failure of the elimination programme particularly in situations of systematic non-compliance with MDA as a challenge to LF elimination (Boyd et al, 2010). Basic lymphoedema management with its emphasis on hygiene and self-care is possible and effective in resource-poor environments, which are endemic for LF (Addiss et al, 2010). Antibiotics or antifilarial medicines do not seem to affect the frequency of ADL attacks, however these simple hygiene measure combined with foot care and application of topical antibiotics or antifungal cream are effective in reducing the frequency of ADL attacks (Shenoy et al, 1995).

In managing morbidity in LF many have advocated for the formation of 'Hope Clubs', but the rural settings where most of the cases are found presents a challenge to the formation of these lymphoedema management support groups. The role of community drug distributors in the morbidity control programme is particularly important because of overburdened health staff and lack of incentives for drug distributors. The success of the lymphoedema management programmes will depend on the involvement of community drug distributors and should therefore address several pertinent issues.

5.6 Rationale

The process of ensuring morbidity control of LF disease involves compiling a morbidity register and training health workers and CDDs on the use and application of the lymphoedema management manual. 'Hope clubs' or 'lymphoedema management support groups' are also encouraged and the programme had an active one at the national level. Free hydrocoelectomies are also provided. Training support from the West Africa Morbidity Project (WAMP) on the WHO recommended method for hydrocoele surgeries and organizing surgical camps with regional and district level medical officers has been undertaken.

Several benefits of lymphoedema management have been noticed with patients that have participated in this programme. They include elimination of bad odour, prevention and healing of entry lesions with improvement of individual's confidence, reduction in size of the affected limbs, improvements in patient's ability to work or attend school. Contacts between communities and health workers have improved where this has been implemented with improvements in MDA compliance. Eventually the quality of life of the patients is generally improved with reduced reliance on other family members due to improvements in their productivity.

Funding presented a huge challenge to the implementation of the morbidity control activities under the programme. Misconceptions about the disease have also brought its own challenges with patients accepting the simple measures taught for lymphoedema management. These are affected by the lack of clean water in most of the rural areas for effective and hygienic limb washing. Most endemic rural communities where cases of elephantiasis are found are scattered, with poor road infrastructure, making the formation of these 'lymphoedema management groups' impossible where they are most needed. The challenge of forming the lymphoedema management support groups has been occasioned by geographical scattering of cases of elephantiasis with little or no monitoring and supervisory visits from health workers. Lack of earmarked funds for supervisory visits led to low compliance among patients with lymphoedema management measures.

Integration of morbidity control activities into control activities of other NTDs whose main strategy hinges on morbidity control has been challenging with inadequate human, logistic and financial resources. In the case of hydrocoele surgeries out-of-pocket payment is demanded for surgeries undertaken as part of routine hospital activities and which are not reported to the programme. Where funds have been provided for reimbursement for surgery payment rates have not matched economic rates.

Ghana began the implementation of the activities of the LF Elimination Programme in 2001. The specific objectives of the LF programme are to interrupt the transmission of the disease through the annual mass administration of anti-filarial drugs, and to alleviate the suffering of those with the disease through lymphoedema management for those with lymphoedema or elephantiasis and hydrocoele surgeries for those with hydrocoeles.

To meet the overall goal of LF elimination one of the specific goals of the programme is to provide alleviation of the suffering of cases of morbidity involving cases of lymphoedema or elephantiasis or hydrocoeles. The aim of the programme was to provide hydrocoelectomies to 60% of all identified cases of hydrocoele and teach lymphoedema management or undertake home-care of swellings of all identified cases of elephantiasis. This involves regular washing of the affected limb or body part, regular exercising at the joints of the affected limb, regular elevation of the affected limb, and proper care of wounds including antibiotic treatment of the affected limb (New Hope Manual) (Dreyer et al, 2000). The need to identify these cases of elephantiasis and hydrocoeles to inform estimates of numbers and organisation of the process is essential and the reason for the need to register the cases during the household distribution of ivermectin and albendazole. Individual household members were simply asked if anyone in the household had elephantiasis or scrotal swellings during the process of MDA. All cases were noted and the numbers recorded and reported as part of the MDA reports submitted annually. Annually the number of cases reported was updated and may include cases that had been identified in previous years.

All identified cases of lymphoedema were provided with the Lymphoedema Management Manual adopted by the programme from the New Hope Manual and produced locally with local pictures to provide guidance to patients (Dreyer et al, 2000). These were given to patients, after the health workers or community drug distributors had taken the patients through the process. The patients with elephantiasis were also supposed to be organised into lymphoedema management support groups, where apart from the training they receive in the management of their condition, they also provide emotional support and counselling to each other to lessen the stigma associated with the condition.

Evaluations of lymphoedema management in Ghana have not been done as compared to that undertaken for hydrocoele surgeries. The fact that elephantiasis or lymphoedema once established is irreversible and can discourage patients from participation in the treatment or management regime. Hence, assessment of the effectiveness of the morbidity control activities under the programme was essential.

Surveys to assess the impacts of morbidity control activities in the first 5 programme districts and hydrocoele surgery activities in the Upper West region were undertaken as a main objective.

The specific objectives were;

- to assess morbidity control activities in selected districts
- to assess the effectiveness of the WHO recommended technique of conducting hydrocoele surgeries in the Upper West region
- to assess the impact of the hydrocoele surgery on the socioeconomic lives of the beneficiaries
- to assess the impact of the surgery on the overall health status of the beneficiaries
- to assess the impact of hydrocoelectomies on individuals' productivity
- to assess the impact of hydrocoelectomies on individual's quality of life

5.7 Method

Cross-sectional morbidity control assessments were conducted in 5 districts for hydrocoele and elephantiasis patients while cross-sectional evaluation of hydrocoele surgeries involving patients who had benefitted from free hydrocoele surgeries was also undertaken. These were done after compilation of longitudinal programme data on morbidity for analysis, presentation and discussion.

5.8 Cross-sectional Morbidity Control Surveys

Cross-sectional morbidity control programme assessment was undertaken as a component of the cross-sectional surveys. A 30-cluster sampling method was applied to the 5 districts. An estimated population of 40 from 8 households was interviewed within each of the 30 clusters for each of the 5 districts. An estimated total of 6,000 individuals were interviewed for the coverage and KAP interviews in the study in Ghana. During this survey cases of lymphoedema or hydrocoele or cases of lymphoedema and hydrocoeles were identified in the households visited and the cross-sectional assessment of morbidity control activities questionnaires administered to these identified LF cases.

5.9 Hyrdrocoele Surgery Assessment in Upper West Region

This part of the study was conducted in all the then 5 districts of the Upper West region. They are Wa, Nadowli, Jirapa-Lambussie, Lawra, and Sissala districts. A list of the 1254 cases of hydrocoele surgeries performed from year 2 to year 5 of the LF Elimination Programme were produced with their address noting carefully the communities in which the cases were located for tracing. About 350 communities were identified for tracking the cases. Designed questionnaires with both open-ended and closed-ended questions, were applied for the interview. All cases identified were administered with the questionnaire and then examined physically for recurrence of the hydrocoele by trained field workers. The listing of the cases was done from the Wa Regional Hospital in the Wa District, Nadowli Hospital in Nadowli District, Jirapa Hospital in Jirapa-Lambussie District, Lawra and Nandom Hospitals in Lawra District and Tumu Hospital in the Sissala District, where the surgeries took place.

Male nursing students were selected and trained as field workers for this survey in order to ensure the participants were comfortable particularly because it involved examination of their genitals in their homes. Again nursing students were used because they have some knowledge of clinical medicine, which made it easy for them to understand the topic, and also made the patients allow them to do the examination. Aside being trained to conduct the interviews, they were also trained to examine for recurrence of hydrocoeles, presence of hernias, presence of lymph scrotum, lymphoedema of the penis and post-surgical wound infection. The training also enabled them to distinguish between hydrocoele and hernia, recognize lymphoedema of the penis, lympho-scrotum and fluid in the scrotum. Translation and back translation of the questionnaire into the local dialect was also done together with role plays. Both qualitative and quantitative data collection methods were applied.

5.10 Presentation of Results

5.10.1 Longitudinal Programme Data

At the inception of the programme health workers were trained to work with the CDDs to ensure registration of all cases of limb and scrotal swellings (suspected cases of hydrocoeles) in their respective endemic districts. The difference between hydrocoeles and hernias, both of which are common scrotal swellings, presented a challenge to health workers, the community drug distributors and the patients. Some of the cases registered were actually hernias and not hydrocoeles. For the purpose of providing surgical treatment for the cases of hydrocoeles, the identified cases are mobilised and screened to ensure that they were hydrocoeles by urologist and medical officers equipped with the skills to provide hydrocoelectomies during surgical camps and then continue to provide these surgeries after the training on a routine basis.

Regular annual updates of morbidity registers were undertaken under the programme. About 10,541 cases of limb swellings or elephantiasis and 5030 cases of scrotal swellings were identified nationally in years 5 and 4 respectively. Between the 5 initial or start-up districts in the programme, a total of 1598 cases of scrotal swellings and 1795 cases of limb swellings or elephantiasis were identified in year 7 and year 3 respectively (Table 5.1). These are the highest values recorded for any particular year since the commencement of the LF Elimination Programme.

Table 5.1: Annual Trends in Reported Hydrocoeles and Elephantiasis Cases from all Implementation Districts

Year	Dist. Reports	At-Risk Pop	Treated	MDA reported coverage	Elephantiasis	Hydrocoeles	Surgeries undertaken
1	5	33,686	246,743	73.9	-	-	-
2	14	1,643,211	1,217,936	74.1	2812	1366	703 (51 + 652)
3	30	3,696,893	2,622,722	70.9	8091	4950	244
4	40	5,378,143	3,971,869	73.9	9931	5030	432
5	60	6,907,375	5,141,482	74.4	10541	4478	365
6	61	8,851,923	6,359,200	71.8	8449	4196	244
7	61	9,278,935	5,932,174	63.9	3845	1109	0
8	74	10,334,602	7,313,521	70.8	-	-	228
9	74	10,199,142	7,882,290	77.3	-	-	0
10	74	9,963,010	74,918,873	75.2	-	-	27
Total			40,687,937		-	-	1744

During surgical camps several doctors from the regional and district levels were trained and about 1744 cases have been provided with free surgery under the programme (Table 5.1). Most of these surgeries were carried out in Ahanta West districts and all the districts in the Upper West region.

Elephantiasis (lymphoedema) and hydrocoeles (scrotal swellings) were reported from year 2 to year 7. The number of cases of elephantiasis registered increased from 2812 in year 2 to 10,541 in year 5 and then reduced to 3845 in year 7. The number of cases of hydrocoele, though many were other scrotal swellings registered, numbered 366 in year 2 and this also increased to 5030 in year 3 and then reduced to 1109 in year 7. Since Year 8, no new cases of either hydrocoeles or elephantiasis were registered during the process of mass drug distribution.

Table 5.2: Annual Trends in Reported Hydrocoele Cases from the 5 Start-up Districts

Reported Cases of Hydrocoeles						
Year	**Ahanta West**	**Awutu Efutu Senya**	**Builsa**	**Kassena Nankana**	**Sissala**	**Annual Total**
Year 2	-	7	-	108	144	259
Year 3	110	16	465	628	94	1313
Year 4	295	30	574	414	107	1420
Year 5	189	21	618	490	79	1397
Year 6	187	4	442	445	40	1118
Year 7	183	29	670	716	-	1598
TOTAL	964	107	2769	2801	464	7105

For these 5 start-up districts on the programme, between a total of 107 to 2769 cases of suspected hydrocoeles or scrotal swellings were reported with most of the reported cases coming from Kassena Nankana and Builsa districts from the Upper East region. The districts reported 2801 cases and 2769 respectively. Ahanta West reported of 964 cases, Sissala reported 464 with Awutu Efutu Senya reporting just 107 cases. Though Builsa district did not report any cases in the Year 1 of the programme it reported almost the same number of cases in total to that reported by Kassena Nankana. Ahanta West reported no cases in Year 1 but in subsequent years reported more cases than Awutu Efutu Senya and Sissala districts. Awutu Efutu Senya district reported the smallest numbers of cases for each of the years and produced the smallest number of cases in total (Table 5.2).

Table 5.3: Annual Trends in Reported Elephantiasis Cases from 5 Start-up Districts

Reported Cases of Elephantiasis						
Year	Ahanta West	Awutu Efutu Senya	Builsa	Kassena Nankana	Sissala	Annual Total
Year 2	-	5	-	206	14	225
Year 3	118	11	694	953	19	1795
Year 4	189	3	741	617	25	1575
Year 5	181	6	626	609	14	1436
Year 6	67	10	622	583	80	1362
Year 7	-	16	0	35	-	51
TOTAL	555	51	2683	3003	152	6444

Cases of elephantiasis were reported from the 5 start-up programme districts. Ahanta West and Builsa districts did not report cases in Year 2, but reported cases in subsequent years. Kassena Nankana and Builsa again reported the highest number of cases of elephantiasis of 3003 and 2683 respectively. Ahanta West reported 555 cases, Sissala district with 152 cases and Awutu Efutu Senya district reported the lowest of 51 cases in total (Table 5.3).

5.11 Cross-Sectional Assessment of Morbidity Control Activities

The hydrocoele surgeries are conducted in hospitals in the endemic districts. In order to ensure that hospitals in endemic districts have the capacity to carry out the recommended technique for the hydrocoele surgeries, there was the need to retrain the medical officers in the recommended technique of hydrocoelectomy. Through the West African LF Morbidity Project doctors in hospitals in selected endemic areas have been trained to perform these hydrocoele surgeries using the WHO recommended technique. The capacity of the medical officers was further strengthened to provide pre-, peri- and postoperative care for hydrocoele cases as a urogenital manifestation of LF.

Hitherto to this support the programme with the support of some of its earlier partners in Year 2 undertook its first Hydrocoele Surgery Training in the Upper West region during which 9 medical officers were trained and 50 surgeries undertaken with support of 3 urologists who facilitated the training. In Year 4 a total of 1254 cases of hydrocoele surgery were performed in the Upper West region alone (Table 5.4).

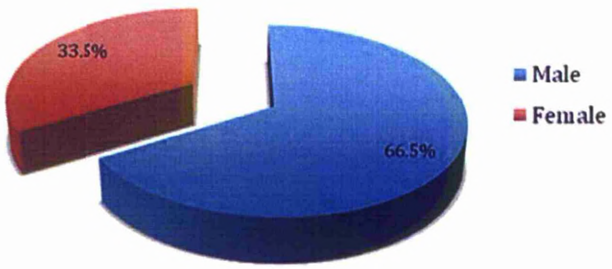
Table 5.4: Number of Patients who underwent hydrocoelectomies in various hospitals in Upper West Region from September 2002 to December 2005

NAME OF HOSPITAL	YEAR / NO. OF PATIENTS				TOTAL NO. OF PATIENTS
	2002	2003	2004	2005	
Jirapa	8	20	44	189	261
Lawra	0	70	18	26	114
Nadowli	13	59	146	118	336
Nandom	30	48	152	167	397
Tumu	0	17	13	0	30
Wa	0	30	59	27	116
TOTAL	51	244	432	527	1254

Cross-sectional morbidity control programme assessment was undertaken as a component of the cross-sectional surveys. A 30-cluster sampling method was applied to the 5 districts. An estimated population of 40 from 8 households was interviewed within each of the 30 clusters for each of the 5 districts. An estimated total sample size of 6,673 individuals was interviewed for the coverage and KAP interviews in the study in Ghana. During this survey cases of lymphoedema or hydrocoeles or cases of lymphoedema and hydrocoeles were identified in each of the households visited and the cross-sectional assessment of morbidity control activities questionnaires administered to these identified LF cases.

The total number of individuals interviewed was 269 made up of patients with hydrocoele or elephantiasis living within the sampled communities of the 5 initial/start-up districts of the programme. No cases with both lymphoedema and hydrocoele were identified.

Figure 5.1: Sex Distribution of LF Patients Interviewed



5.12 Social and Economic Characteristics of Identified Cases

The respondents were made up of 179 (66.5%) males and 90 (33.5%) females (Figure 5.1). About 176 (65.4%) were married, 12.1% were single, 6.7% were divorced and 10% were widowed. About 2 (0.7%) of the respondents did not have their marital status indicated on the questionnaire. The majority of those interviewed were involved in farming (71.0%), followed by fishing (8.6%), then trading (6.7%). Those who worked as teachers (1.5%) or artisans (3.7%) were in the minority.

5.13 Assessing Management of Elephantiasis

About 40.9% of the patients with elephantiasis indicated that they were aware of the availability of treatment for persons with elephantiasis. However, 28.6%

said the available treatment was a form of medication, while 30.1% said they were aware of surgical treatment. Those that indicated both surgery and medication were 38.7% while those that indicated other forms of treatment formed 40.9% (Table 5.5).

Table 5.5: Knowledge of Available Treatment for elephantiasis

<table>
<tr><th>Available Treatment for elephantiasis</th><th>Frequency (N)</th><th>Percentage (%)</th><th>Percentage (%)</th></tr>
<tr><td>Medication</td><td>77</td><td>28.6</td><td rowspan="4">Yes = 40.9%</td></tr>
<tr><td>Surgery</td><td>4</td><td>30.1</td></tr>
<tr><td>Medication and Surgery</td><td>23</td><td>38.7</td></tr>
<tr><td>Other forms of treatment</td><td>6</td><td>40.9</td></tr>
<tr><td>NA</td><td>159</td><td>59.1</td><td>No = 59.1%</td></tr>
<tr><td></td><td>269</td><td>100.0</td><td>100.0</td></tr>
</table>

Only 6 (2.2%) of the 269 cases interviewed owned a copy of the lymphoedema management manual which was produced and distributed to all endemic regions and districts by the elimination programme in Ghana and out of this number 5 had been taught the application of this lymphoedema management manual (Table 5.6).

Table 5.6: Ownership and Application of Lymphoedema Management Manual

Response	Ownership of Manual		Application of Manual	
	Frequency (N)	Percentage (%)	Frequency(N)	Percentage(%)
Yes	6	2.2	5	1.9
No	104	38.7	3	1.1
NA	159	59.1	261	97.0
Total	269	100	269	100

Inspite of the fact that few (2.2%) of the respondents owned copies of the lymphoedema management manual (Table 5.6) more knew about the proper care of lymphoedema and actually practiced some of the prescribed methods limb care. About 8.2% of the patients practiced limb washing, 7.1% practiced limb exercising but only 0.7% practiced limb elevation. About 2.6% of the patients knew and had undertaken proper care of wounds on the affected limbs, which might involve the application of antibiotics (Table 5.7).

Figure 5.2: Application of Manual

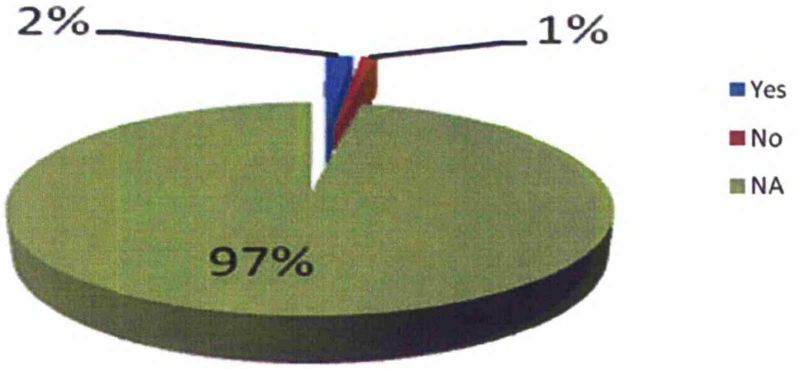


Table 5.7: Practice of Lymphoedema Management

Applied care of affected limb	Frequency (N)	Percentage (%)
Limb washing	22	8.2
Exercising	19	7.1
Limb elevation	2	0.7
Proper wound care	7	2.6
Other	49+12	23.3
NA	158	58.7
Total	269	100

Among those that knew about the management of lymphoedema cases and also applied all or some of methods, 3 (1.1%) indicated that they noticed no change in the frequency of acute attacks, and though 2 (0.7%) actually indicated that inspite of undertaking this practice of lymphoedema management they had actually noticed a increase in the number of acute attacks they experienced in a year while 13 (4.8%) had actually noticed a decrease in the number of acute attacks they experienced in a year (Table

5.8). These proportions, though small, indicate the expected outcome of home management of lymphoedema. It is expected that patients who diligently applied the measures taught in the lymphoedema management manual would notice a decrease in the number of acute attacks suffered by these elephantiasis patients until these acute attacks finally ceased. Also about 10 (3.7%) of the patients interviewed had noticed a decrease in size of the affected limbs after practicing limb washing, elevation, exercising and undertaking the proper wound care. Some 6 (2.2%) of patients had noticed no change while 2 (0.7%) said the affected limbs had actually grown bigger (Table 5.8).

5.14 Assessing Management of Hydrocoeles

Generally most 137 (50.9%) patients were aware of the availability of treatment for hydrocoele, while 23 (8.6%) were not. 116 (43.1%) had attempted to seek treatment for their condition, while 44 (16.4%) had not. These forms of treatment included both orthodox and non-orthodox treatment for cases of hydrocoeles (Table 5.9).

Table 5.8: Outcome of Lymphoedema Management among Elephantiasis Patients

Outcome of Lymphoedema Management among Elephantiasis Patients					
Changes in acute attacks	**Frequency (N)**	**Percentage (%)**	**Change in size of limb**	**Frequency (N)**	**Percentage (%)**
No change	3	1.1	No change	6	2.2
Yes, increasing	2	0.7	Yes, getting bigger	2	0.7
Yes, decreasing	13	4.8	Yes, getting smaller	10	3.7
NA	251	93.3	NA	251	93.3
Total	269	100.0	Total	269	100.0

Table 5.9: Treatment Seeking Behaviour of Hydrocoele Cases

Response	Awareness of Hydrocoele Surgery Treatment		Attempts to seek treatment	
	Frequency	Percentage	Frequency	Percentage
Yes	137	50.9%	116	43.1%
No	23	8.6%	44	16.4%
NA	109	40.5%	109	40.5%
Total	269	100.0%	269	100.0%

Among the respondents, 22 (8.2%) indicated they knew about certain forms of orthodox medication which could be applied in the treatment of hydrocoele. About 80 (29.7%) knew that surgery was the main form of treatment and while 43 (16%) knew about surgery and medication was available treatment for hydrocoeles. The others, that formed 5.6% and numbered 15, knew about other forms of treatment not indicated (Table 5.10).

About 86 (32%) of the respondents had had surgical treatment for their hydrocoeles, and 65 (24.2%) said the outcome of the surgery was good, however, 16 (5.9%) said the outcome was bad due to complications of the surgery. About 33 (12.3%) of the patients had benefitted from free surgical treatment while (54) 20.1% did not and had to bear the total cost of this surgery (Table 5.11).

Table 5.10: Known Forms of Available Treatment among Hydrocoele Patients

Known Forms of Available Treatment among Hydrocoele Patients		
Type of Treatment	Frequency	Percentage
Medication	22	8.2%
Surgery	80	29.7%
Medication and surgery	43	16.0%
Other forms of treatment	15	5.6%
NA	109	59.5
Total	269	100.0%

5.15 Results of Assessment of Hydrocoelectomy in Upper West Region

Out of the 1254 cases listed only 302 could be located for participation in the survey, and therefore 952 cases could not be followed up for the survey. Majority (50.3%) of the survey participants were located in Lawra district, followed by Jirapa-Lumbussie (18.2%), Wa (12.3%), Nadowli (11.9%), Sissala (6.0%) and the least (1.2%) came from outside these 5 districts though these 4 people identified had their names on the list of hydrocoele surgeries performed under the programme but resided outside but close to the region (Figure 5.3). The average age of the respondents was 54 years with the youngest being 4 years (suggesting possible congenital hydrocoele) while the oldest was 92 years. The average household size was 8.2 people

Figure 5.2: Participation in Survey by District

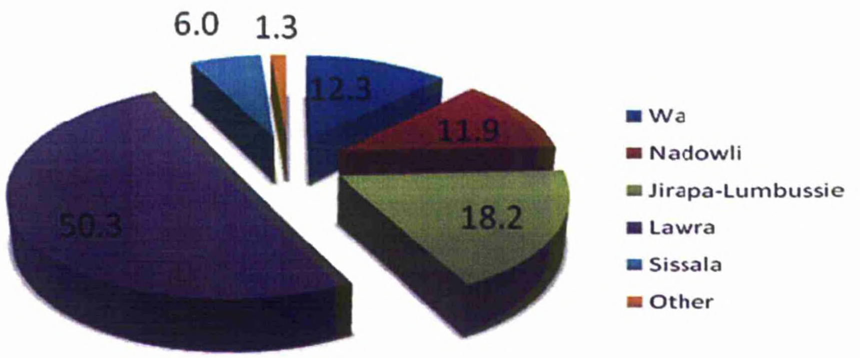


Figure 5.4: Educational Status of Respondents

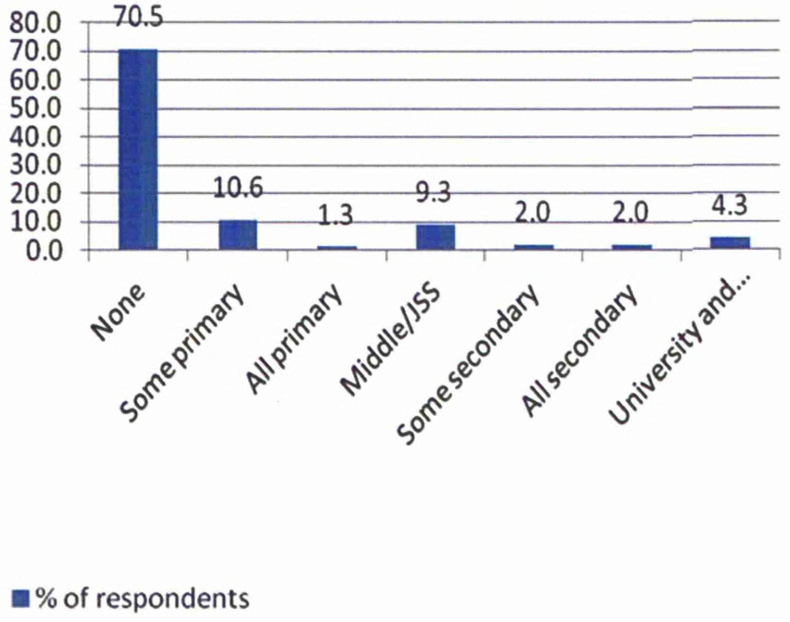


Figure 5.5: Reasons for not attending school

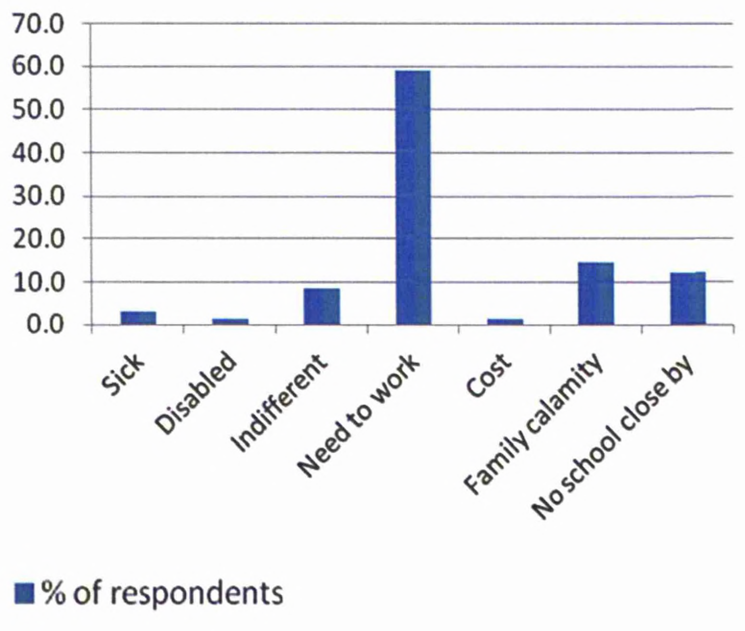


Table 5.11: Costs and Outcomes of Surgical Treatment

Costs and Outcomes of Surgical Treatment								
Offered Surgical treatment?	**Frequency**	**Percentage**	**Was treatment free?**	**Frequency**	**Percentage**	**Treatment outcome?**	**Frequency**	**Percentage**
Yes	86	32.0%	Yes	33	12.3%	Good	65	24.2%
No	73	27.1%	No	54	20.1%	Bad	16	5.9%
	1	0.4%	Other	1	0.4%	Other	6	2.2%
NA	109	40.5%	NA	181	67.3%	NA	182	67.7%
Total	269	100.0%	Total	269	100.0%	Total	269	100.0%

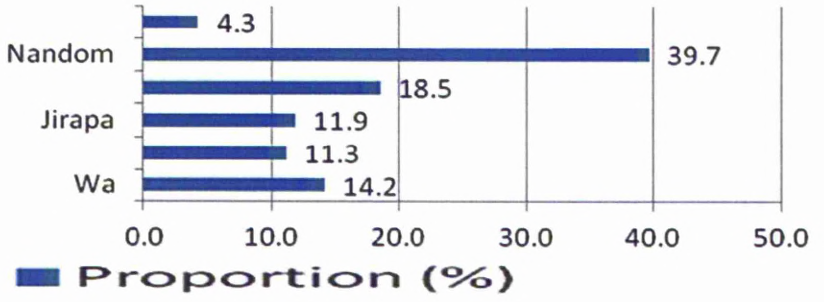
Among the respondents, married ones formed 85.1%, 2.3% were divorced, 3.3% were widowed and 9.3% were single. As expected in rural areas of the northern part of the country the educational level of respondents was generally low. Over 70.5% of them had received schooling and could neither read nor write. The remaining 29.5% had had some level of education most of which was rather low. Those who had had some primary or completed primary education were 11.9%, middle school or Junior Secondary education, some secondary or completed secondary education was 13.3% and those with tertiary education was 4.3%. Among those who had had some education, 17.5% of them could read and 17.9% could write. 37 (12.3%) study participants were eligible to be in school but only 10 (3.3%) were actually in school. About 16% of the 213 respondents who had not had any formal schooling had had non-formal education (Figure 5.4). Several reasons were given why these eligible participants were not in school. About 3.0% said it was because they were sick, 1.5% disabled, 8.3% indifferent, 59.1% needed to work, 1.5% because of cost, 14.4% attributed it to a family misfortune and 12.1% said it was because there was no nearby school (Figure 5.5).

5.16 Clinical Background and Short-Term Surgical Results

The Upper West region has 6 health facilities capable of undertaking hydrocoele surgeries and these are the facilities, which were attended by the study participants for their surgery. About 43 (4.2%) of the evaluated surgeries were done at the Wa Hospital, 34 (11.9%) at Nadowli (, 36 at Jirapa, 56 at Lawra, 120 at Nandom and 13 at Tumu Hospitals respectively. The study participants had had their hydrocoeles for an average 9.5 years with 36 of them having been operated for recurred hydrocoele after a previous surgery (Figure 5.6).

The medical records of the study subjects indicated that 30.8% of the respondents had bilateral hydrocoele and had undergone excision (169) or eversion hydrocoelectomy, while the rest had no record of the surgery performed. According to the available surgical records almost all the surgeries (99.3%) were performed under local anaesthesia. Only one case was done under general anaesthesia while no record was found for one case. Antibiotic prophylaxis was applied in 299 (99.0%) of the surgeries. The duration of hospital stay for patients was between 1-31 days depending of the rate of recuperation and incidence of post-surgical complications with an average hospital stay of 6.6 days. However, complications and co-morbidities were found in the medical records of only one case following surgery. The main post-surgical complications reported were bleeding and infection. Some 20.2% of respondents reported infections within 10 days of the surgery and 10.9% reported bleeding within the same period post-surgery.

Figure 5.6: Distribution of Cases among Health Facilities



5.17 Long-Term Surgical Outcomes

The time interval between the surgeries of the study participants and the time of the evaluation averaged 1.9 year. During this period 3.7% of the participants reported recurrence of the hydrocoeles. The wounds of 22.8% of the patients had healed by secondary intention. About 16.9% of the study participants indicated in their interview that they had some problems after the surgery. On physical examination, 1.7% of the respondents were found to have lymph-scrotum, 0.7% had lymphoedema of the penis, 12.3% had hernia and 9.9% had some fluid present in the scrotum which could not be confirmed by the field workers to be hydrocoeles.

5.18 Cost of surgery

The study participants after spending an average of 6.6 days in hospital also spent an average of 118.2 days to achieve total recovery after their surgeries. About 55% of them had to pay some monetary contribution for the surgery or medicine. About 85.1% of the patients had someone accompany them for surgery. Average direct cost per surgery to patient was ¢128,655.00 ($14.30) and to the caregiver was ¢47,000.00 ($5.22). Average indirect cost of surgery to patient was ¢2,092,200.00 ($232.47). Average indirect cost of surgery to caregiver was ¢127,050.00 ($14.12). The average total cost of surgery was therefore ¢2,394,905.00 ($266.10) per case.

5.19 Treatment-Seeking Behavior and Cost of Post-Surgical Treatment

About 222 (73.5%) of the study participants indicated that they sought further post-surgical treatments for various symptoms they associated with the surgery. About 137 (45.4%) of these people sought this post-treatment from Government/Mission hospitals or clinics, 5 (1.7%) from a private clinic or hospital, 4 (1.5%) from traditional healer, 38 (12.6%) from a community health worker and 38 (12.6%) from a pharmacy or chemical seller (Table 5.12).

About 31.5% of patients who sought post-surgical treatment paid for consultations and/or medicines out of pocket and in 0.6% of cases were accompanied by another person on these visits. The average direct cost of post-surgery treatment was ¢86,789.37 ($9.64) and the average indirect cost was ¢48,963.75 ($5.44). The average total cost of post-surgery treatment to patients therefore was ¢135,753.12 ($15.08). For those who sought post-surgery treatment from government or mission facility, 91.2% of them said the treatment helped very much, 8.1% said it helped a little and 0.7% said there was no difference. About 3 (60%) of the 5 (1.7% of total) who went to a private facility said it helped very much, 1 (20%) said it helped a little and the other 1 (20%) said there was no difference. For those who went to the traditional healer, 3 (75%) said the treatment helped very much and 1 (25%) saw no difference. About 97.1% of those who went to the community health worker said the treatment helped very much and 2.9% said it helped a little. Treatment from the pharmacy helped 78.4% of the patients who went there very much and 21.6% of them, a little (Table 5.12).

Table 5.12: Post-Surgery Treatment Seeking Behaviour

Source of treatment	No. of patients Seeking Treatment	Proportion of Patients Seeking Treatment (%)	Response to Treatment (%)		
			helped	helped a little	no difference
Gov./Mission clinic/hosp	137	45.4	91.2	8.1	0.7
Private clinic/hosp	5	1.7	60	20	20
Traditional healer	4	1.5	75	25	0
Community health worker	38	12.6	97.1	2.9	0
Pharmacy	38	12.6	78.4	21.6	0

5.20 Patient Quality of Life

About 92.4% of the respondents had no problem with the hydrocoele surgery, 7.0% had some problems and 0.6% wished they had not had it done at all however, about 88.5% of the respondents had the problems they had with their hydrocoeles solved after the surgery.

Table 5.13: Post-surgery treatment-seeking behavior of patients

Source of treatment	No. of patients	Percentage
Gov't/mission clinic/hosp	137	61.7
Private clinic/hosp	5	2.3
Traditional healer	4	1.8
Community health worker	38	17.1
Pharmacy	38	17.1
Total	222	100.0

5.21 Quality of Life after Hydrocoele Surgery

The study participant's quality of life was also measured by their response to their ability to work, change in economic life, family and sex life questions on a graded scale. The response rate however varied for each of these questions though not significantly. For their ability to work the response rate was 99.3% but 63.3% of respondents thought their ability to work was much better, 25.0% said a little better, 6.7% but said no difference while 5% said there was no difference. The response rate for the question on economic life was 97.7%, however much better response came from 42.7% of respondents, a little better 28.2%) and 25.4% and 3.7% for no difference and worse respectively. The response rate on changes in family life showed 56.5% for much better, 22.4% for a little better, 19.1% for no change and 2.0% for worse (Table 5.14). The response rate for changes in sex life was the lowest (90.3%).

About 40.3% of respondents said it was much better, 14.6% said a little better, 3.7% said there was no change and then 3.7% said it was worse (Table 5.14).

Though hydrocoele surgery had generally improved the quality of life of the beneficiaries of the hydrocoele surgeries greater impacts of the surgeries were expected than what the responses provided. The difference between those groups that had indicated they had experienced change and those who are not experienced any change or had had those indicators worsen (fig 5.7 and 5.8). With regards to their sex life the group that experienced improvements formed 54.9% and those that did not experience any improvements formed 45.1%, a difference of 9.9%. The group that experienced improvements in family life was 78.9%, those that experienced no improvement was 21.1% with a difference of about 57.9% between the two groups. The group that experienced improvement in their economic life after the surgery was 70.8% and those that did not were 29.2% giving a difference of 41.7% between the these two groups. Finally the group that experienced an improvement in their ability of work was 88.3% while those that did not formed 11.7% giving a difference of 76.7% (Figure 5.7 and Figure 5.8).

Table 5.14: Change in Quality of Life (QoL)

Aspect of life	Degree of change	No. of people	Percentage	Age	
				Range	Mean
Ability to work	Much better	190	63.3	4 - 90	50.1
	A little better	75	25.0	6 - 90	59.8
	No difference	20	6.7	28 - 85	59.3
	Worse	15	5.0	15 - 92	60.4
Response Rate		300	99.3		
Economic life	Much better	126	42.7	4 - 90	48.8
	A little better	83	28.2	25 - 90	58.3
	No difference	75	25.4	18 - 92	60.1
	Worse	11	3.7	31 - 77	56.8
Response Rate		295	97.7		
Family Life	Much better	169	56.5	4 - 92	50.4
	A little better	67	22.4	19 - 90	60.5
	No difference	57	19.1	31929	59.6
	Worse	6	2.0	31 - 85	61
Response Rate		299	99.0		
Sex Life	Much better	110	40.3	23 - 90	51.1
	A little better	40	14.6	25 - 90	58
	No difference	113	41.4	18 - 92	60.3
	Worse	10	3.7	33 - 80	59.8
Response Rate		273	90.4		

Figure 5.7: Changes in Aspects of Life

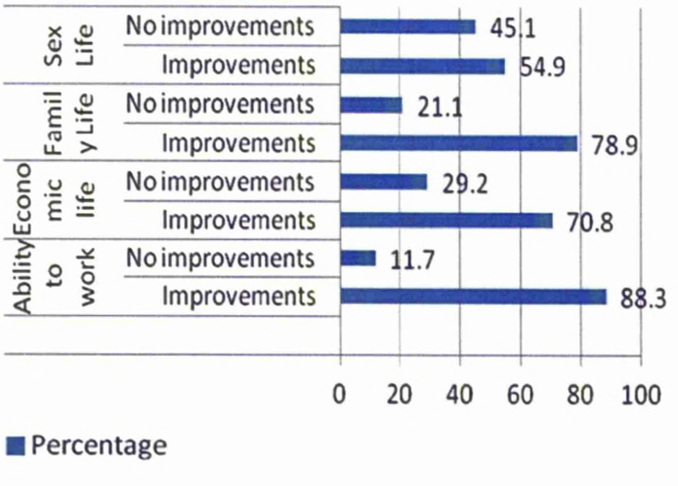
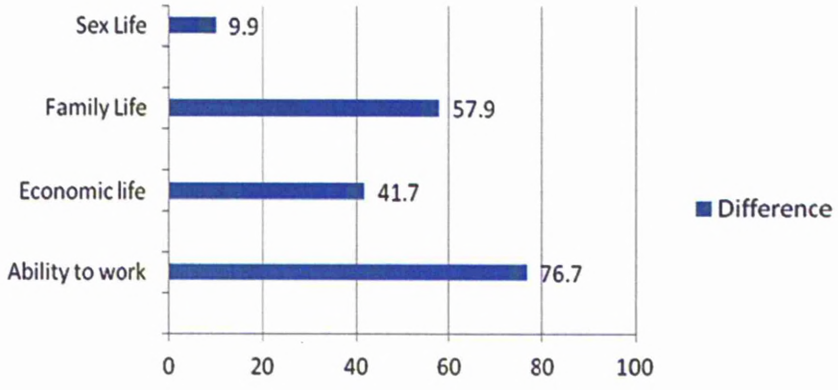


Figure 5.8 Differences between Experience of Change and No Change



Based on these results it can be inferred that hydrocoele surgery made the greatest impact on the study participants ability to work, followed by their family life, and then their economic life. Hydrocoele surgery made the least impact on the sex life of the study subjects.

Table 5.15: Improvements in Patients Pre- and Post-surgery Problems

Problem	Pre-surgery	Post-surgery	Age of those with problems post-surgery	
			Range	Mean
% of respondents with any problem in mobility	66.6	9.9	26 -92	68.4
% of respondents with any problem in self care	34.8	3.6	59 - 77	69.4
% of respondents with any problem in usual activities	59.8	12.3	59 – 77	69.1
% of respondents with any problem in pain/discomfort	82.7	24.2	59 - 77	68.3
% of respondents with any problem in anxiety/depression	71.8	17.6	61 - 77	68.0

Generally the quality of life of the patients improved after surgery. These were measured by study participants indicating whether or not they noticed improvements in their mobility, self care, and ability to undertake daily activities, problems with pain or discomfort, problems with anxiety or depression. About 66.6% of the respondents indicated that they had problems with mobility pre-surgery but only 9.9% still had problems with mobility after the surgery. Improvements in self care were from 34.8% pre-surgery to 3.6% post-surgery. About 59.8% of the patients said they had problems undertaking usual activities within their communities but 12.3% said they still had these problems post-surgery. The number of individuals with pain and discomfort associated with the hydrocoeles also improved from 82.7% pre-surgery to 24.2% post-surgery. With regards to anxiety and depression, 71.8% the respondents indicated that they had symptoms indicative of this conditions but this improved to 17.6% (Table 5.15). The age range of respondents who complained of the various symptoms were 26-92 (mean 68.4) years for problems with mobility, 59-77 (mean 69.4) years with problems with self-care, 59-77 (mean 69.1) years with problems with usual daily activities, and then 61-77(mean 68.0) years with problems with anxiety or depression (Table 5.15). With a mean age of all respondents being 54 years it can be assumed that old age was associated with these post-surgery problems considering that the mean age for each the set of patients with these pre- and post-surgery problems was approximately 70 years.

Table 5.16: Infections observed in cases operated at the various facilities

Hospital	Cases examined	Cases infected	% of cases infected
Wa	43	10	23.3
Nadowli	34	9	26.5
Jirapa	36	7	19.4
Lawra	56	17	30.4
Nandom	120	23	19.2
Tumu	13	3	23.1
TOTAL	302	69	22.8

The prevalence of postoperative infections observed among respondents operated on at the different facilities ranged from 19.2% to 30.4% with an average of 22.8% for all the cases (Table 5.16). Field workers picked up these infections through physical examination of the surgical scars. These serve to delay the healing process and contributed to the post-surgical problems experience by respondents. This could also be associated with age since immunity and ability to fight infection reduces with age and could result in the post-surgical pain and discomfort, reduced mobility resulting in problems with self-care and usual daily activities of the individual. The end effect could be anxiety and depression.

For the qualitative data collected the findings indicated that most of the participants started having problems with hydrocoele after a mean period of 2.6 years from the onset of the condition. The problem was attributed to headaches, general pains, abdominal pains and discomfort and pulling sensation among 72.6% of respondents. About 11.7% attributed it to inability to walk and 3.9% attributed it to the large size of the hydrocoele. However, those that said their problems had been mitigated by the surgery attributed this to the absence of headaches, general pains, chills and abdominal problems but 1.0% of respondents and 15.2% said they could now walk.

Respondents attributed reduction in their ability to work after the surgery to pain, weakness and simple inability to work as before and weakness. Those who said their economic situation is worse were 8 because they cannot work or don't work anymore. Those who said the surgery has made their family life worse than it was before the surgery gave reasons of not being able to provide for their families any longer and one said that surgery made him weak.

Those who said the surgery made their sex life worse than before attributed it to their inability to achieve an erection and feelings of pain and inability of the wife to become pregnant after the surgery. Two people said they wished they hadn't gone for the surgery because the swelling had even grown bigger.

Figure 5.9: Patients' Quality of Life after Surgery

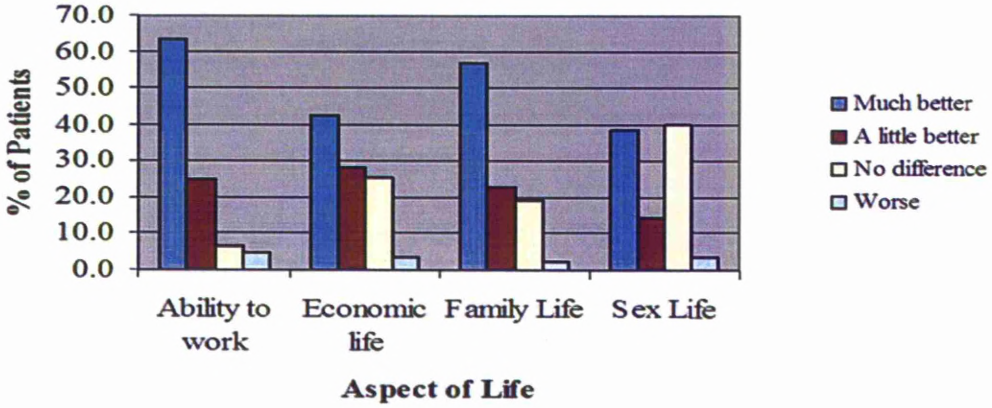
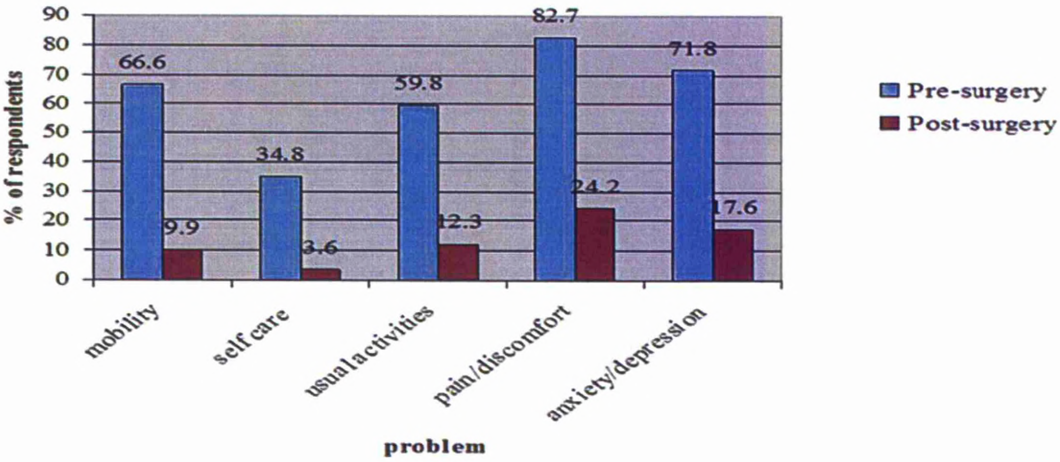


Figure 5.10: Euro-Qol Results for Patients



When respondents were asked for suggestions as to how to make the surgery better, they had been satisfactorily treated with no problem and asked that the health system continued with the good work. They also suggested money should not have been collected from them. They asked for mosquito nets to be provided in the hospital, for drugs to be made available in the hospital and more drugs to be given to patients, others asked for financial help to facilitate work on his farm, while some wanted regular examination and health education on hydrocoele to ensure better health for them.

The hydrocoele surgery evaluation was conducted in the Upper West Region in year 6 of the LF Elimination Programme implementation. The objectives of the survey were to assess the effectiveness of the technique used in hydrocelectomy in Ghana and the impact of hydrocoele surgery on the overall health and the socio-economic life of beneficiaries of the service.

A total of 302 beneficiaries were identified for the survey in the Wa, Nadowli, Jirapa-Lambussie, Lawra and Sissala Districts with very few of them residing in districts outside the region. All these surgeries had been done at the Wa, Nadowli, Jirapa, Lawra, Nandom and Sissala Hospitals.

The recommended technique, which was used for almost all of the surgeries evaluated, was total excision of the hernia sac, the tunica albuginea. Of all the evaluated cases, 3.6% reported recurrence but upon examination, 9.9% were, however, found to have fluid present in scrotum indicating recurrence. Excision remains a good technique for hydrocoelectomy since more than 90% of the cases did recover with no recurrence. The hydrocoele surgery programme has thus made a significant impact on the effective delivery of hydrocoelectomy service in the districts whose medical officers and surgeons the programme has retrained. There were improvements in the socio-economic life of the study participants after the surgery. Their general state of health status also improved. There were a few problems with the surgery and there was a high level of satisfaction (92.4%) with surgery among the respondents.

Hydrocoeles aside from limiting mobility are also associated with stigma (Babu et al, 2009) and restrict migration or travelling for socioeconomic purposes. Successful surgery will contribute to increased migration to urban areas, farms and other areas with greater income generation potential. These are factors that might have come into play resulting in the absence of many of the successfully treated individuals from their communities. Majority of the respondents, 70.5%, had not had any formal education. The region is generally rural and deprived in terms of social amenities and services, and the primary occupation of more than 90% of the people is farming (*Annual Report, 2006). This is even supported by the reasons given by those respondents who were of school- age but were not in school. About 12.4% of them said it was because there was no school close by, and 59.1% said they needed to work, probably on their parent's farms. The mean of the time interval between the onset of the individual hydrocoele and the surgery was 9.5 years. This could be due to the absence of quality and reliable service and more importantly the absence of free hydrocoele surgery services prior to the LF Programme's surgical interventions, which started in year 2. Activities of the programme have also created awareness of the condition and also avenues for surgery, which could be free.

The surgical technique applied was mainly total excision of the hydrocoele sac as recommended by the WHO, which was not the technique of choice prior to this programme for hydrocoele surgeries. In the past eversion of the sac was the technique of choice. The cases were also mainly done under local anaesthesia. Antibiotic prophylaxis was appropriately given considering the challenge of maintaining strict pre- intra- and post-operative sepsis in such district peri-urban environments. Average hospital stay was also 6.6 days another means of minimizing post-surgical infections. However, 20% reported post operative infection, and 10.9% bleeding within 10 days following surgery. Upon examination, 22.8% of them were found to have had infection of the wound. Infection rates ranged from 19% in Jirapa and Nandom to 30% in Lawra which is high across all operating facilities. This is also linked to poor socio-economic infrastructure and limited hospital equipment and medicines required. These facilities are known to be constrained in the performance of such surgeries. Most patients are discharged home to live under relatively unhygienic conditions and had to start visiting their farms to work where the wounds are further exposed sources of infection. Furthermore, about 44.7% of them did not seek any treatment after surgery and even some of those that sought it might have done so only after infections had set in.

Indirect costs to patients due to average hospital stay of 8.6 days and 118.2 days off work for full recovery was about GH¢209.22 ($232.47). As mainly patients were mainly farmers more days were required for total recuperation post-surgery before work and most would not work during the recovery period. Loss of income during this period accounts for most of the indirect costs. Costs to the caregiver was both directly of GH¢4.70 ($5.22) and indirectly of GH¢12.71 ($14.12). An estimated direct cost to patient was GH¢1,286.55 ($14.30). Also it costs the caregiver an average of ¢47,000.00 ($5.22) directly and ¢127,050.00 ($14.12) indirectly due to the number of days spent with the patients in the hospital. The patient pays on average ¢1,286.55 ($14.30) as direct cost of surgery which is made up of cost of surgery, medicine, transport, food and other costs related to the surgery. Patients did not pay for the actual surgery but other related costs. However, the average total cost of surgery of ¢2,394,905.00 ($266.10) is a huge economic loss to the patient or the family as a whole.

Post-surgery treatment was sought mostly from the government facility, followed by the community health worker and the pharmacy, and then private facility and traditional healers who also follow in that order (Tables 5.12 and 5.13). The main reasons for this observation are financial and physical accessibility to the service. Government facilities though strategically sited close to communities tend to offer cheaper and more reliable services. It is cheaper to receive treatment from government facility and the community health worker. These facilities are also close to the people and where they are lacking, the community health workers are available to help fill the gap. Few of the participants visited the traditional healer. Modernization has distanced most people from such traditional healers due to past experiences and the success rates evident from the health services compared to the traditional healers. Financial constraints might have led the few that visited the traditional healers to seek their help.

Many (90%) of the study participants said surgery had solved their problem causing some (11.6%) to change their occupation for better ones. As a result of surgery they now enjoy better quality life and demonstrated by the ability to work achieving an improved economic prospects, family life and sex life (Figures 5.7, 5.8, 5.9 and 5.10) though a few said the quality of their life had not improved or actually worsened (2-5%). This group has an average age of between 56.8-61 years (Table 5.8, 5.9 and 5.10) and thus age could be the determining factor rather than surgery. The group that had erectile problems were aged between 50-80 (average 67.8%). This present state of good health might have caused the high levels of absenteeism during the evaluation as a result of migration to Southern Ghana for better job opportunities.

5.22 Discussion

In Ghana LF has been found to be prevalent in the northern and southern parts of the country leaving the central belt almost clear of the disease. In managing morbidity, surgery has been found to be very effective with few or no cases of recurrence of hydrocoele. Recurrence was mainly due to poor surgical technique. However, the management of lymphoedema with limb washing, exercising and limb elevation presents significant benefit and hope for patients with the condition but the challenge is that total remission is not possible though patients who have adhered religiously to this management have experienced marked improvements in the condition of the affected limbs.

The programme provides free surgical treatment to hydrocoele patients in endemic areas when available. But this support has been inconsistent and has not been available during the last 5 years. When it was available it was restricted to the Upper West region due to the source of the funding which focused on this region. Recent efforts to extend the provision of hydrocoele surgery have focused on training for surgeons on total excision hydrocoelectomies.

Generally attention devoted to morbidity management on the programme by all partners including the Government of Ghana through the programme has been inadequate, though what has been provided in terms of surgical treatment for those with hydrocoeles has made significant impact on the conditions of the patients involved. The same can be inferred for patients with lymphoedema who have had the opportunity of being educated on lymphoedema management and have been able to apply the skills learnt. More males than females were identified with the LF disease and to participate in the study. None of the identified cases had both elephantiasis and hydrocoeles. Men aside being possible cases of elephantiasis also develop hydrocoeles which is not found among the women accounting for the greater number of men who had the disease and were interviewed. Most of these patients were also married and were mainly subsistence farmers. Apart from the finding that the disease affected more men than the women; the other observed socio-economic characteristics are similar to those generally observed in the country.

Some patients who had been provided with information on lymphoedema management and had also been able to undertake these taught skills had however indicated that their condition was worse since the number of acute attacks they experienced had increased or the size of their affected limbs had also increased. This observation is often indicative of lack of compliance among the patients due to poor understanding of these taught skills. They are therefore unable to properly apply them or they do not practice the limb washing, limb elevation, limb exercising and proper case of wounds on the affected limb. Some started but also stopped at a point when they realized that these are practices they are expected to adhere to for the rest of their lives particularly when they saw little, slow or no improvements in their condition though they apply these measures.

The longitudinal programme data indicated that majority of the registered cases of limb swellings were cases of lymphoedema or elephantiasis that were planned to be provided with the lymphoedema management booklets for the purpose of ensuring lymphoedema management for these patients. Due to challenges of funding the lymphoedema management component became inactive with time and discouraged the health workers and the CDDs from continued registration of the cases. Also many districts did not register the cases from the time the programme began implementation. The number of cases therefore reported formed only a small proportion of both elephantiasis and hydrocoele. The scattered nature of the cases geographically particularly of elephantiasis registered also hindered the formation of Lymphoedema Management Support groups or 'Hope Clubs' recommended as part of the lymphoedema management process.

According to prevalence surveys on LF undertaken prior to the inception of the programme, there was an indication that the disease was more prevalent in the northern parts of the country than in the south (Gyapong 2000; Gyapong et al, 1993, 1994). Even though it is suspected that there were significant gaps in the collection and reporting of the cases of hydrocoele the information gathered tends to support the known geographic distribution of disease. Over the years though free hydrocoele surgery treatment was provided for mobilised cases in surgical camps and on a routine basis it was not expected to have impacted significantly on the numbers registered annually though through this programme greater awareness of the disease and the availability of surgical treatment might also have encouraged many identified cases to seek treatment for their condition. The number of reported cases is therefore an indication of the efficiency with which the health workers implement the programme because all districts are expected to have cases and even though some districts reported no cases in Year 1 cases were reported in subsequent years. The number of cases reported each year was supposed to be updated in subsequent years and therefore could include cases that had been identified in earlier years.

With elephantiasis it is not expected that the reported number of cases undertaken annually will change significantly since the condition is chronic, irreversible and the swelling does not undergo any significant reduction or improvements with the size of the affected limb. However, the measures introduced are able to reduce and eventually stop the occurrence of acute attacks thus preventing the affected limb from getting worse in size. For the cross-sectional morbidity surveys, more males than females were identified with the LF for interview. None of the identified cases had both elephantiasis and hydrocoeles. Men aside being possible cases of elephantiasis also develop hydrocoeles which is not found among the women thus accounting for the greater number of men who were interviewed. Most of these patients were married and were subsistence farmers. Apart from the finding that the disease affected more men than the women; the other observed socio-economic characteristics are similar to those generally observed in the country.

The total number of individuals interviewed wase 269 made up of patients with hydrocoele or elephantiasis living within the sampled communities of the 5 initial/start-up districts of the programme.

5.22.1 Assessing Management of Elephantiasis

Awareness of treatment for elephantiasis among patients was low (40.9%) and the kind of treatment referred to seem to be different for different categories of the patients interviewed as none of them indicated the recommended hygiene measures, limb exercising or elevation (Tables 5.15 and 5.16). Ownership of the lymphoedema management manual produced and distributed by the programme was also very low (2.2%) in spite the fact that the programme had produced and distributed many copies of this manual. The few that had the manual had been taught its application. Interestingly a few more people who did not have the manual knew about the proper care of lymphoedema, implying that in the absence of the manual teaching the patients the proper management and ensuring adherence to the measures was possible and should be undertaken.

Added to the low awareness and practice of lymphoedema management among respondents, 3 (1.1%) of those practicing lymphoedema management indicated that they noticed no change in the frequency of acute attacks. About 2 (0.7%) actually indicated that inspite of undertaking lymphoedema management they had actually noticed an increase in the number of acute attacks they experienced in a year while 13 (4.8%) had noticed a decrease in the number of acute attacks experienced in a year. These low proportions agree with the expectation that patients who knew and diligently applied the measures taught in the lymphoedema management manual would notice a decrease in the number of acute attacks suffered by patients until these acute attacks finally ceased. Reductions in the size of the affected limb among patients who also knew and practiced lymphoedema management, is also an expected outcome while advanced cases may experience minimal or no change in the size of the affected limb (Dreyer, 2000; Brantus, 2009).

5.22.2 Assessing Management of Hydrocoeles

Assessment carried out with hydrocoele cases indicated that awareness of the availability of treatment was much higher than in the case of elephantiasis. Patients also knew about hydrocoele surgeries being the main orthodox method of treatment. This is expected as hydrocoeles are well recognised by the population. Some of the cases of hydrocoele benefitted from free surgery and individuals were happy with the outcome. This is indicative of the role the programme had played in reducing morbidity due to hydrocoele. This aspect of the programme, which has had more support in, terms both of funding and technical assistance and should be encouraged. Unfortunately the few who indicated that the outcome of the surgery was unsatisfactory would serve as poor advocates for the programme and MDA.

5.23 Conclusions

The free hydrocoele surgeries organized by the National LF Programme has made a major and positive impact on the physical, social and economic life of the people who have benefited from the service. They would hitherto not have been able to access hydrocoele surgery due to the cost constraints. The surgery has greatly improved the general health and physical state of the beneficiaries from a pre-surgery level of 58.6% to post-surgery level of 85.6%. In spite of the fact some patients had problems with the surgery, a high proportion of them (92.4%) were very satisfied with the surgery.

Excision is the recommended technique being used and is also what the West African Morbidity Project is promoting. The technique remains effective even though there were few recurrent cases. More than 90% of the cases did not recur. The programme has therefore made a great impact on the delivery of quality hydrocoele surgery service to patients in the study districts. This is because about 76.5% of all the cases done in the Upper West Region from 2000 to December 2005 were undertaken with the support of the LF Elimination Programme.

There were improvements in the socio-economic life of the study participants after the surgery. Their general state of health also improved in spite of a few post-operative challenges some of the cases had experienced. Hydrocoeles asides from limiting mobility are also associated with stigma (Perera et al, 2007: Hotez, 2008) and restrict migration or travelling for socioeconomic purposes. Successful surgery resulted in migration to urban areas, distant farms and other areas of with greater income generation potential.. These are factors that might have come into play resulting in the absence of many of the successfully treated individuals from their communities.

Activities of the programme have also created awareness of the condition and availability of free surgery. The programme has therefore made available quality, reliable and more importantly free hydrocoele surgery services to alleviate the suffering of patients. This is despite poor socio-economic infrastructure, limited hospital equipment and medicines required. Facilities are known to be constrained in the performance of such surgeries. Most patients are discharged home to live under less ideal conditions and began farming to work where the wounds would be exposed to infection from the soil. Furthermore, about 44.7% of them did not seek any treatment after surgery and even some of those that sought it might have done so only after infections had set in.

Loss of income during this period of the surgery and recuperation accounts for most of the indirect cost to patients. Other indirect costs were accounted for time spent with patients by caregivers. However, the average total cost of surgery of ¢2,394,905.00 ($266.10) represents a huge economic loss to the patient or the family as a whole.

Post-surgery treatment was sought mostly from the government facility, followed by the community health worker and the pharmacy, and then private facilities and traditional healers who also follow in that order (Tables 5.12 and 5.13). Government facilities are often strategically sited close to communities to offer cheaper and more reliable services to patients. Few of the participants visited the traditional healer. Modernisation has distanced most people from such traditional healers due to past experiences and the success rates evident from the health services compared to the traditional healers.

Surgery had caused most of the patients to enjoy a better quality life demonstrated by the ability to work and improved economic life, family life and sex life (Figures 5.7, 5.8, 5.9 and 5.10). This present state of good health might have caused the high levels of absenteeism during the evaluation as a result of migration to Southern Ghana for better job opportunities.

In order to achieve the elimination targets of LF, the need to reinforce morbidity control activities is essential. Registration of all identified cases of both scrotal and limb swellings should be done and regularly updated. Training of heath workers and community drug distributors to enable them effectively play the role of also training and supervising lymphoedema management among patients while helping to identify all cases within endemic communities. There should also be follow up and confirmation of all cases of hydrocoele from other causes of scrotal swellings. Training of doctors in hospital within endemic areas on the recommended method for undertaking these hydrocoele surgeries is absolutely essential so they can better handle these surgeries in order to prevent recurrence of the condition. `

It is recommended that the districts improve access to the service. Furthermore, it is recommended that the activities of the LF Elimination Programme be given a higher emphasis in the other regions as has been done inthe Upper West Region to enable the people benefit more from the available package.

Partnerships in support of morbidity control and in particular in support of free hydrocoele surgery should be encouraged. Apart from their role in alleviating the suffering of cases of hydrocoeles and elephantiasis they serve as a strong community advocacy tool for endemic communities.

Chapter 6

Impact of Mass Drug Administration on Immunoparasitologic Indicators of Bancroftian Filariasis

Chapter 6: Impact of Mass Drug Administration on Immunoparasitologic Indicators of Bancroftian Filariasis

6.1 Introduction

The Ghana Filariasis Elimination Programme (GFEP) was set up in June 2000 after completing its mapping process and developing an endemic map to guide the programme. The employed strategy of MDA was based on the WHO guidelines for preparing and implementing the LF Elimination Programme in countries, which are co-endemic for LF and onchocerciasis. This strategy recommends the use of ivermectin and albendazole treatment regimens to be undertaken annually for identified implementation units (WHO, 2000). These guidelines also recommend the need for a surveillance plan for the programme, which should involve both endemic areas and non-endemic areas. In Ghana monitoring the progress of the LF elimination programme using immuno-parasitological indicators involved several surveys during the lifetime of the elimination programme. The main activities were mapping the distribution of the disease (Gyapong et al, 2002), baseline data collection from selected sentinel sites, longitudinal monitoring surveys and surveys to determine the end point of MDA.

Though it was anticipated that 5-6 years of MDA (WHO, 2000; WHO 2001) should be adequate to ensure elimination of LF, operational research experience has provided evidence to the contrary. Up to six years of MDA has been found to be inadequate to ensure a reduction in mf parasite prevalence to levels (less than 1%), which are unable to sustain transmission of LF. Various scenarios that make this challenging include areas with evidence of high mf prevalence and density before the commencement of MDAs and areas of with low coverage or compliance with MDA (Addiss, 2010). Urban environments contribute to low compliance or coverage due to socioeconomic factors and urban dynamics that challenge the distribution process (Addiss, 2010). In all this, the local vector characteristics and the applied drug regimen also play an important role in determining the possibility of achieving elimination within the set time period (Addiss, 2010). Addressing these challenges requires further operational research with the development of tools and strategies to guide programme implementation (Addiss, 2010).

Monitoring the impactof MDA on transmission of LF in Ghana has involved several impact assessments surveys. These have largely been based on WHO guidelines and protocols, whose development and implementation have been led by the WHO and its partners. These include the 'Programme Managers Manual for Implementing MDA in countries co-endemic for LF and onchocerciasis' (WHO, 2000) and 'Preventive Chemotherapy (PCT) in human helminthiasis: coordinated use of antihelminthic drugs in control interventions: a manual for health professionals and programme managers' (WHO, 2006c). Challenges encountered by countries like Ghana in implementing these guidelines have contributed to the revision of these guidelines. Recent guidelines developed to guide the process of implementing mass chemotherapy and monitor the impacts including the determination of the end point of mass preventive chemotherapy for elimination programmes have been put in place particularly for LF (WHO, 2000; WHO, 2006, Ottesen, 2006). Disease specific focus is still maintained to ensure that indicators for specific PCT disease monitoring are not lost and this has informed the methods employed for undertaking these impact assessments.

The district was designated as the implementation unit. Prior to beginning MD using ivermectin and albendazole, the programme set up sentinel sites and collected baseline data for longitudinal monitoring. Most endemic districts having completed the minimum of 5 rounds of MDA require programme decisions to stop MDA being an elimination programme. Since mapping the distribution of LF in Ghana, longitudinal impact assessment data has been regularly collected as part of the LF elimination strategy since inception of the programme; however this has often been tailored to the availability of financial, human and logistic resources.

The impact assessments undertaken during the programme since its inception have involved the collection of longitudinal programme data from the year 2000 to 2009. The major impact assessment of the five start-up districts, which were the first to complete the minimum of five rounds of MDA, was undertaken in 2007.

6.2 Methods for Longitudinal Monitoring of Immuno-parasitogic Indicators

Countrywide antigen prevalence data was initially collected for mapping of LF distribution in Ghana using the 50km grid method (Gyapong et al, 2002). The result was a prevalence map, which indicated that LF was endemic in 49 out of the then 110 endemic districts in Ghana (Gyapong et al, 2002). This has been used to guide MDA on the Ghana Filariasis Elimination Programme (GFEP), now part of the NTD Programme. Baseline microfilaraemia prevalence data was also collected and applied for monitoring the impact of LF in Ghana (Ghana Health Service Unpublished, 2004; Ghana Health Service Unpublished, 2007-2012).

The Ministry of Local Governments undertook several redemarcations of the administrative districts in Ghana. In 2003, the number of administrative districts changed from 110 to 138, and the number of endemic districts changed to 61. Then in 2007 there was another change to 74 endemic districts based on a change in administrative districts to 170. The programme also underwent a gradual up-scaling plan of implementation from the initial five start-up districts out of 110 districts to all of the present 74 districts in 2006 (Table 6.1 and Figure 6.1) (ghanadistricts.com). For monitoring, the programme maintained the original 49 districts and further re-demarcated the country into evaluation units for the purpose of impact assessments.

Table 6.1: Upscaling Plan of the Ghana Filaraisis Elimination Programme Indicating the Number of Implementation Units (Districts) by Implementing Year

Implementing Year	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	Total Number of Districts for Ghana
Number of Implementation Units (Districts)	5	14	30	40	48	49	110
	6	18	38	51	60	61	138
	8	24	46	61	72	74	170

Antigen prevalence data using ICT card antigen tests were collected for countrywide LF endemicity maps (Gyapong et al, 2002). The programme collected baseline and other longitudinal data to help monitor the impact of initiated MDA in several study communities referred to as sentinel and cross-check sites.

6.2.1 Diagnostic Methods

Laboratory tests employed for these assessments included the collection of thick and thin blood smears for the detection of microfilaraemia and ICT card test for antigenaemia (World Health Organization, 2000). The Og4C3 and Bm14 ELISA tests were employed for the cross-sectional studies to detect new infections in children born after the institution of MDA. Selected sentinel and cross-check communities in districts that have achieved a microfilaraemia prevalence of less than 1% were employed to determine the possible end points of MDA in these districts and others with similar characteristics. With these tools for undertaking tests for filarial antigen and antibody detection and microfilaria detection in blood smears, baseline data, follow-up data and end point determination data were collected.

For the identified endemic districts the initial recommendation was to select two sentinel and one cross-check sites per an implementation unit or a population of a million for monitoring of the impact of the programme (WHO, 2000). The characteristics of these sites were to have a stable and minimum population of 500, areas of high disease prevalence and high vector density among other parameters that enhance the transmission of LF. For this sample size of individuals' night blood samples were collected for blood smear examination for microfilaraemia. During the sample collection the individuals with lymphoedema and hydrocoeles were registered and the prevalence of lymphoedema and hydrocoeles noted. Microfilaraemia prevalence and mean microfilaraemia density were calculated (WHO, 2000; WHO, 2006, Ottesen, 2006).

The recommended frequency of monitoring involved collection of baseline samples, samples before the 4th round of mass drug distribution and then subsequently before every 2nd round of distribution. Finger prick blood taken at night was collected for the bloods smears from which microfilaria prevalence and microfilaria mean densities were calculated. After completion of a minimum of 5 annual rounds of MDA and monitoring the fall of prevalence to less than 1% in all sentinel and cross-check sites, the programme could continue to undertake an assessment of interruption of transmission or determination of the end point of MDA, now called the transmission assessment surveys (TAS) (WHO, 2000; WHO, 2006, Ottesen, 2006).

Modifications were made to the recommended WHO methods in implementation of monitoring and evaluation to match funding and logistic availability. Timing of the monitoring activities influenced the number of sites that could be visited for any particular annual survey. The number of people sampled depended on voluntary participation of community members in the surveys and therefore the resulting sample sizes.

6.3 Results and Discussions on Longitudinal Monitoring of Immuno-parasitological Indicators

6.3.1 Results of 2000 Immunoparasitologic Surveys

Baseline data was collected in 2000 before the first annual MDA in the programme's five start-up districts. These districts were Awutu-Efutu-Senya district in the Central region, Ahanta West in the Western region, Builsa and Kassena Nankana district in the Upper East region and Sissala district in the Upper West region. Between four and six communities were visited for each of these districts in an effort to meet the recommended sample size of approximately 500 for this survey. For this survey, night blood smears for microfilaraemia and ICT card tests for antigenaemia were conducted for the samples collected in each of these districts. In all a total of 2607 people were sampled from these 5 districts with the sample size varying from 441 in Builsa district to 662 in Ahanta West district (Table 6.2). A total of 607 microfilaraemic positive individuals were detected. The number of microfilaraemic positive individuals ranged from 90 in Sissala to 139 in Kassena Nankana district. Microfilaraemia prevalence was therefore between 19.8% and 29.6% as the mode. The median was 23.4%. Antigen prevalence by the ICT card tests were between 33.1% and 45.4%. The average mf prevalence for the whole survey was 23.3% while that for antigen prevalence was 38.1% (Table 6.2).

Table 6.2: Summary Baseline Survey Data Collected for the Five Start-Up Districts at Inception of the Programme

2000 Baseline Survey Data					
Community	Number Examined (N)	Microfilaria Positive (N)	Microfilaria Prevalence	ICT Positive	ICT Antigen Prevalence
Winneba	606	144	23.8	216	35.6
Kassena Nankana	469	139	29.6	213	45.4
Sissala	429	90	21.0	159	37.1
Builsa	441	103	23.4	186	42.2
Ahanta West	662	131	19.8	219	33.1
National	2607	607	23.3	993	38.1

The disease prevalence in these districts was generally high (ref), which was a reason for their selection for the start-up programmes. In addition the initial research activities aimed at establishing the endemicity of LF were conducted in these five districts. Sissala, Builsa and Kassena Nankana districts also border adjacent endemic districts of Burkina Faso where the MDA with ivermectin and albendazole programme was also commencing making it epidemiologically prudent to complement this treatment by ensuring the Ghana programme treated the communities on its side of the border (Kyelem et al, 2003)

6.3.2 Results of 2001 Immuno-parasitologic Surveys

Prior to the second round of MDA a further survey was undertaken for 9 districts (Table 6.3) mainly in northern Ghana. In all, 2 communities were visited for each district visited. About 200 people were sampled for each of these districts. Only Lawra had 175 people volunteer to participate in the survey. A total of 1775 people were sampled for these surveys and 1346 were antigen positive by the ICT card test. The average prevalence for the entire survey was 76%. Antigen prevalence therefore ranged from 59-85% (Table 6.3).

Table 6.3: 2001 Night Blood Survey Results showing Antigen Prevalence using ICT Card Tests

2001 ICT Card Test Results			
DISTRICT	**Number of People Tested (N)**	**Number of ICT Card Test Positive**	**Antigen Prevalence Rate Using the ICT Card Test (%)**
Wa	200	169	85
Lawra	175	129	74
Jirapa	200	118	59
Nadowli	200	163	82
Sissala	200	155	78
Kasena Nankana	200	169	85
Builsa	200	156	78
Bongo	200	146	73
Bolga	200	141	71
SUMMARY	1775	1346	76

Serious technical challenges due to poor timing of the surveys and the ICT test card quality were encountered for this survey. This may have been due to the weather conditions as the surveys were undertaken in the cold dry dusty harmattan weather. Though samples were collected for both blood smears and antigen tests, the slides were heavily contaminated with dust particles making processing and reading of the slides impossible and so the results had to be abandoned. Vasoconstriction due to the cold weather made bleeding of individuals for the survey also difficult particularly between 10pm and 2am. The newly introduced ICT card test required reading of test results within 10 minutes of dropping the blood on the kit. Samples were collected and kept overnight leading to a high turnover of false positive readings. The results obtained for both the antigen card tests and blood slides for microfilaraemia could therefore not be applied for programmatic decision-making.

6.3.3 Results of 2002 Immuno-parasitologic Surveys

Surveys were conducted in 2002 in five districts in the Northern, Upper East, Central and Western regions. These surveys focused on the second set of new districts that were recruited for programme implementation. Participation in these surveys was generally low for Agona and Nzema East districts. A total of 1784 people from a total of 10 communities participated in the survey (Table 6.4). The ICT card tests for antigenaemia were only applied for Agona and Nzema East districts due to the limited availability of the ICT cards.

Microfilaraemia prevalence was generally low and ranged from 0% in Nzema East district to 7.4 percent in Agona district. East Mamprusi, West Mamprusi and Nzema East each had a prevalence of less than 1%. Bawku East had a prevalence of 4.2%. Antigen prevalence by the ICT card tests were 23.5% in Agona and 13.6% in Nzema East (Table 6.4). No antigen tests were conducted in the other districts surveyed.

6.3.4 Reults of 2003 Immuno-parasitologic Surveys

The 2003 blood surveys were an opportunity to conduct mid-term impact assessments of the programme's first five start-up districts. Baseline data was also collected for a selection of districts that were being recruited into the programme for the first time. A total of 15 districts were sampled for this survey. Participation in the surveys was very low in some communities. Sample sizes therefore varied from 46 in Jirapa district to 557 in Shama Ahanta East, an urban area.

A total of 2514 individuals participated in the surveys. The ICT antigen tests were conducted on 1643 with an overall antigen prevalence of 5.8% and overall microfilaraemia prevalence was 3.9% (Table 6.5). At the regional level, antigen prevalence ranged from 3% in the Northern region to 39% in Upper East region while microfilaraemia prevalence was from 0% in the Northern region to 15% in Upper East region. Parasite counts were highest in the Upper East region followed by the Upper West region, but low in the Central and zero in the Northern region. Districts surveyed in the Upper East and Upper West regions had the highest prevalence levels for microfilaraemia of between 10% and 28.3% and 0% to 20% respectively. Northern and Central regions generally had low levels, though Western region had prevalence between 0.2% and 10%.

6.3.5 Results of 2004 Immuno-parasitologic Surveys

The 2004 blood surveys were undertaken in 10 districts (Table 6.6) and involved 25 communities. One district was visited in each of the six regions where these surveys were undertaken. A district was sampled from the Northern, Brong Ahafo, Eastern and Greater Accra regions. Four and two districts were surveyed in the Upper West and Upper East regions respectively. Twenty five communities were visited in an effort to improve on the number of samples required per site visited. The numbers of communities visited in each district were three in Northern, Eastern and Greater Accra regions, four in Upper East and Brong Ahafo regions while eight were surveyed in the Upper West region. The total sample size was 2933 (Table 6.6).

The microfilaraemia prevalence obtained nationally was 5.9% with an antigen prevalence of 17.5%. District microfilaria prevalence ranged from 0.2% in Greater Accra region to 16.0% in the Upper West region. Antigen prevalence followed similar trends as for the microfilaraemia prevalence (Table 6.6).

Table 6.4: 2002 Night Blood Survey Results showing Antigen and Microfilaraemia Prevalence

Region	District	Number Positive (N)		People Examined	Prevalence (%)	
		Microscopy for Microfilaraemia	**ICT Card Test for Filaria Antigen aemia**		**ICT Card test for Filaria Antigenaemia**	**Microscopy for Microfilaraemia**
Upper East	Bawku East	21	-	505	-	4.2
Northern	East Mamprusi	1	-	230	-	0.4
Northern	West Mamprusi	5	-	714	-	0.7
Central	Agona	10	32	136	23.5	7.4
Western	Nzema East	0	27	199	13.6	0.0
SUMMARY	5	37	59	1784	3.3	2.1

6.3.6 Results of 2005 Immuno-parasitologic Surveys

The 2005 blood surveys were conducted in 10 districts and involved 34 communities. In order to obtain an adequate sample size for the surveys, several communities were visited in the selected districts. This survey was conducted before the round five of mass drug distribution of the five start-up districts (WHO, 2001) and involved the collection of samples for both antigen tests using ICT cards and bloods smears for microfilaraemia.

A total of 4822 individuals including 230 children less than five years with the rest belonging to different age groups were sampled. Among the adult population microfilaraemia prevalence was 2.1%, but antigen prevalence was 2.6% within the under five age-group and 6.8% within the older age groups for the disaggregated data (Table 6.7). Nzema East, Awutu-Efutu-Senya and Sissala districts with sample sizes of between 15-22 had antigen prevalence among the under five age group of 0% while Ahanta West, Agona, Kassena Nankana, Builsa and Nadowli districts with sample sizes from 24-51 had antigen prevalence from 2.3-4.2% within the under five year group (Table 6.7). No children under five years were sampled in East and West Mamprusi districts.

Table 6.5: 2003 Immuno-parasitologic Survey Results showing Antigen and Microfilaraemia Prevalence

REGION	Number of Districts Sampled	Number of individuals sampled (N)	RESULTS (N)		Prevalence (%)	
			ICT Positive	Microfilaria Positive	ICT	Microfilaria
Upper West	5	415	14	33	14	8.0
Upper East	4	353	39	53	39	15.0
Northern	1	486	3	0	3	0.0
Central	3	603	11	1	11	0.2
Western	2	657	28	11	5	4.3
NATIONAL	15	2514	95	98	5.8% (No. Spld=1643)	3.9% (no. Spld=2514)

REGION	Number of Districts Surveyed	Number of Communities Surveyed	RESULTS				
			Number of People Sampled	Number of People Positive for Microfilarmemia (N)	Microfilaraemia Prevalence (%)	Number of People Positive for ICT Antigen test	Antigen Prevalence (%)
Upper West	4	8	729	117	16.0	146	20.0
Upper East	2	4	156	19	12.2	44	28.2
Northern	1	3	516	17	3.3	103	21.6
Brong Ahafo	1	4	530	15	2.8	50	35.5
Eastern	1	3	519	5	1.0	5	1.8
Greater Accra	1	3	483	1	0.2	38	7.9

National	10	25	2933	174	5.9	386	17.5

Table 6.6: 2004 Blood Surveys Results showing Antigen and Microfilaraemia Prevalence

Table 6.7: 2005 Summary Night Blood Survey Results showing Antigen and Microfilaraemia Prevalence and Antigen Prevalence among Children under Fiver Years

Region (5)	Districts (10)	Number of Communities	Microfilaraemia		ICT	
			Number of Sampled	Microfilaria Prevalence.	Adult Antigen ICT Prevalence	Under Four Years ICT Antigen Prevalence
Western	Ahanta West	3	502	3.2	15.5	3.9
	Nzema East	3	371	0.0	2.0	0.0
Central	Awutu Efutu Senya	4	500	0.2	6.2	0.0
	Agona	4	465	1.3	10.9	4.2
Northern	East Mamprusi	3	474	0.0	0.4	-
	West Mamprusi	3	505	1.2	5.5	-
UWR	Kassena Nankana	4	505	4.0	7.1	3.8
	Builsa	3	500	3.6	11.2	2.3
UER	Nadowli	3	500	6.4	7.0	3.3
	Sissala	4	500	0.0	1.5	0.0
National	10	34	4822	2.1	6.8	2.6

6.3.7 Results of 2007 Immuno-parasitologic Surveys

The 2007 blood surveys were part of the cross-sectional study undertaken. It focused on the five start-up districts and employed blood smear tests for microfilaraemia and Og3C4 and Bm14 ELIZA tests for filarial antigen and antibodies for determining the infection levels in children up to five years who were born since the inception of the mass drug distribution programme for LF elimination in these districts that have completed six rounds of mass drug distribution and needed a determination of the possible end points of the distribution programme. Two sentinel sites and one cross-check site were surveyed for each district. For each of these sites a sample size of 500 individuals was targeted for the adult surveys. Sentinel sites with fewer numbers due to small population sizes or due to poor participation had adjacent communities visited to achieve the 500 samples required. The results of the Og3C4 and Bm14 ELISA tests are presented under the chapter on determining the end points of MDA.

For the 2007 blood surveys, five districts, 15 sub-districts with a total of 59 communities, which are organized into 15 sentinel or cross-check sites. In all, a total of 7643 adult samples were collected for the blood smear tests for microfilaraemia. Out of this number 244 were found to be positive for microfilaraemia giving a total national prevalence of 3.2% for this major assessment involving Ahanta West, Awutu Efutu Senya, Kassena Nankana, Builsa and Sissala districts. Prevalence of microfilaraemia by district ranged from 0.6% in Awutu Efutu Senya district to 6.9% in Builsa district. In between these Kassena Nankana had a prevalence of 4.0%, Ahanta West had 2.2% and then Sissala district had 2.1%. The average number of individuals sampled for each of these districts was about 510 which is above the required sample size, Awutu Efutu Senya and Kassena Nankana districts had an average sample size of 432 and 489 (Table 6.8) which was less than recommended. Participation in the survey in these districts was therefore lower than the other three districts.

Table 6.8: Summary Results of 2007 Blood Surveys by Sub-districts

Region	District	Sub-district	No. Comm	MF Positive	Total Surveyed	MF Prev.	Parasites	Density
Upper West	Sissala East	Kunchugu	6	21	688	3.05	417	331.61
	Sissala West	Jeffisi	5	13	523	2.5	53	68.08
		Gwollu	3	2	541	0.4	2	16.70
Upper East	Builsa	Chuchuluga	4	18	536	3.4	224	207.82
		Wiaga	3	35	344	10.2	352	167.95
		Fumbisi	5	54	675	8.0	433	133.91
	KND	Navrongo	4	12	507	2.4	186	258.85
		Paga	4	27	411	6.6	588	363.69
		KND South	3	19	550	3.5	110	96.68
Western	Ahanta West	Apowa	4	29	719	4.0	535	308.09
		Dixcove	3	4	348	1.1	12	50.10
		Agona/Princess	3	2	504	0.4	12	100.20
Central	Efutu Municipal	Winneba	3	3	349	0.9	113	629.03
		Winneba	5	4	443	0.90	17	70.98
	Awutu Senya	Bontrase	4	1	505	0.2	1	16.70
NATIONAL			59	244	7643	3.2	3055	209.09

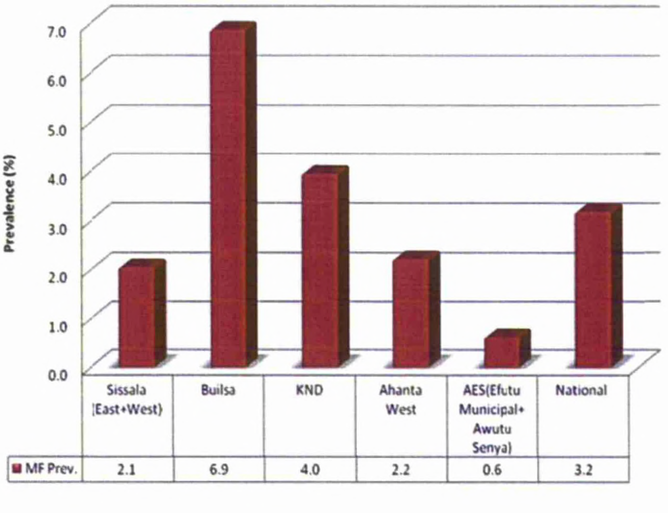
Table 6.9: Summary Results of 2007 Blood Surveys by Districts Microfilaraemia Prevalence in the Five Start-Up Districts

Region	District	Positive	Negative	Total	MF Prevalence (%)
Upper West	Sissala (East+West)	36	1716	1752	2.1
Upper East	Builsa	107	1448	1555	6.9
Upper East	Kassena Nankana	58	1410	1468	4.0
Western	Ahanta West	35	1536	1571	2.2
Central	Awutu Efutu Senya (Efutu Municipal+Awutu Senya)	8	1289	1297	0.6
NATIONAL		244	7399	7643	3.2

The district prevalence for microfilaraemia was more than 1% for all the districts except Awutu Efutu Senya district. The Awutu Efutu Senya districts had a prevalence of 0.6%, followed by Sissala (2.1%) in the Upper West and Ahanta West (2.2%) in the Western region, then Kassena Nankana (4.0%) and Builsa (6.9%) (Table 6.8 and 6.9). This indicates that at the district level only Awutu-Efutu-Senya district could proceed to undertake the TAS leading to stopping MDAs. At the sub-district level prevalence ranged from 0.2 in Awutu Efutu Senya district to 10.2 in Kassena Nankana district. Also parasite counts were lowest (1) in Awutu Efutu Senya district and highest in Kassena Nankana district (588).

This assessment indicates that Awutu Efutu Senya district had obtained a fall in prevalence to below 1% at the district level and also had both its two sentinel and one cross-check site also with mf prevalence less than 1%. Awutu-Efutu-Senya district is therefore the only district that met the criteria for proceeding to undertake TAS leading to the possible decision to stop MDAs. Among these start-up LF programme districts only Awutu Efutu Senya district had produced evidence which could eventually lead to stopping MDAs in that implementation unit.

Figure 6.2: Summary Results of 2007 MF Prevalence by Districts



6.3.8 Results of 2009 Immuno-parasitologic Surveys

In 2009, blood surveys conducted were conducted in 15 districts. This survey was carried out during the process of reviewing the LF Monitoring and Evaluation Manual which recommended surveys are conducted in one sentinel instead of two and then a cross-check site. Apart from one district in which the old method was applied all the other 14 districts followed this new WHO recommendation. In each of these districts, one sentinel and one cross-check site were selected in accordance with new draft recommendations/guidelines for monitoring and determining the end points of MDA. A sample size of 500 was targeted for each of the sites visited. The draft recommendations that informed the method and the sampling for this survey had not been published when the surveys were started in Agona district and therefore two sentinel and one cross-check were sampled in Agona district surveys. Blood samples were taken for blood smears and microfilaraemia prevalence and densities determined for each site. District prevalence was determined from the aggregated data and further aggregated to provide information on national prevalence. A total of 31 sentinel and cross-check sites were assessed in this survey.

A total of 15,175 people from 113 communities made up of 31 sentinel and cross-check communities and adjacent communities were sampled. About 342 individuals were positive for microfilaraemia giving a national level prevalence of 2.3% with an mf parasite density of 405.5 mf/dl of blood for the parasite positive individuals. Microfilaraemia prevalence by districts ranged from 0.0-8.2% while prevalence by sentinel and cross-check site ranged from 0.0-12.9% (Table 6.10 and 6.11). The results of the surveys indicated that out of the 15 districts surveyed the aggregated district prevalence data indicates that 8 out of the 15 districts have prevalence levels less than 1% and might therefore need to proceed to undertake the TAS which will eventually lead to the decision to stop MDAs in those districts or not. Out of the 31 sentinel and cross-check communities 17 (54.8%) of them had mf prevalence less than 1% while 14 (45.2%) had mf prevalence levels more than 1% (Table 6.11).

District assessment of the results by sentinel and cross-check sites indicated that seven districts had all of its assessed sites with prevalence less than 1% and therefore qualified for further assessment that would lead to stopping of MDAs while eight districts had at least one site with a prevalence of more than 1% therefore did not qualify to continue with further TAS. MDA in all these two categories of districts therefore needs to continue.

Table 6.11: Results of 2009 Blood Surveys

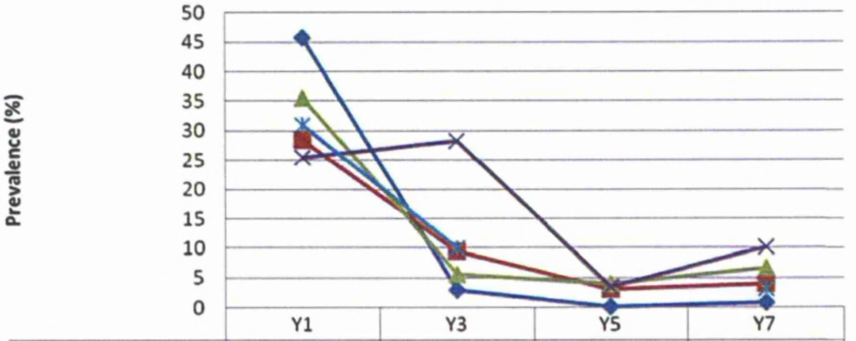
NIGHT BLOOD SURVEY 2009							
			Microscopy				
Regions (5)	District	Number of Communities	Sample Size	Microfilaria Positive	Prevalence. (%)	Parasite Count	Density
Central (1)	Agona	10	1199	0	0.0	0	0
Western (2)	Tarkwa Nsuaem	5	664	1	0.2	34	567.8
	Axim Municipal	7	596	17	2.9	891	875.276
Upper West (4)	Lawra	9	1074	81	7.5	2440	503.062
	Nadowli	6	969	20	2.1	429	358.215
	Wa	9	1228	101	8.2	2494	412.374
	Jirapa	7	1325	33	2.5	452	228.739
Upper East (3)	Bolgatanga	9	1037	31	3.0	301	162.152
	Bongo	8	1007	34	3.4	307	150.791
	Bawku West	6	978	14	1.4	643	767.007
Northern (5)	West Mamprusi	8	1160	7	0.6	300	715.714
	Tolon Kumbungu	9	1025	2	0.2	11	91.85
	Savelugu Nanton	8	954	0	0.0	0	0
	Zabzugu Tatale	6	956	0	0.0	0	0
	Nanumba	6	1003	1	0.1	2	33.4
TOTAL	15	113	15175	342	2.3	8304	405.488

6.4 Observed Trends from Impact Assessments

Generally downward trends have been observed across the five study districts with very significant reduction in microfilaria prevalence of LF microfilaria from the beginning of the programme to date (Figure 6.3). Using aggregated district prevalence data indicates that mf prevalence surveys have been consistently carried out in the five start-up districts from year one through to year nine as indicated by the available prevalence data. Similar downward trends can also be demonstrated by all implementing districts based on all survey mf prevalence data (Figure 6.4).

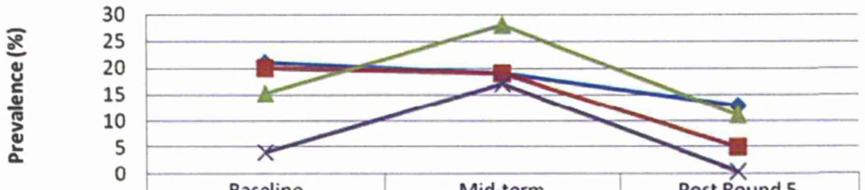
During the up-scaling of programme implementation, selection of districts was based on the prevalence level with higher prevalence districts beginning programme implementation earlier than the lower prevalence districts. Also districts that had been surveyed prior to the inception of the programme and whose data led to the establishment of the endemicity of LF in Ghana like Kassena-Nankana and Ahanta West districts were considered as start up districts for the programme. Other districts, which bordered Burkina Faso where adjacent districts had started LF programme implementation, were also considered (Gyapong et al 2002; Kyelem et al 2003). These factors informed the selection of the first five start-up districts for implementation of the LF programme in Ghana for year one and further selection for subsequent years. Metropolitan districts like Accra were added on to the programme very late due to anticipated issues with urban drug distribution.

Figure 6.5: Observed Trends in Microfilaraemia Prevalence among the First Five Start-Up Districts



	Y1	Y3	Y5	Y7
AES	45.7	2.9	0.2	0.9
Ahanta West	28.5	9.5	3.2	4
Kassena Nankana	35.5	5.5	4	6.6
Builsa	25.5	28.3	3.4	10.2
Sissala	31	10		3.1

Figure 6.6: Observed Trends in Microfilaraemia Prevalence among Selected Districts from Second Set of Districts Joining the Programme



	Baseline	Mid-term	Post Round 5
Wa	21	19	12.9
Lawra	20	19	5
Jirapa	15.2	28.1	11
Nadowli	4	17	0.4

In AES prevalence levels have declined from 45.7% at baseline to 2.9% at mid-term, then further to 0.2% in before year six and finally 0.9% after year six which is less than the required threshold of 1% and therefore qualified to have further TAS undertaken for stopping MDAs. Ahanta West has also seen significant reduction of mf prevalence for the district from 28.5% at baseline to 9.5% at mid-term, 3.2% before year six and 4.0% after year six. Inspite of the reduction demonstrated, the last mf prevalence of 4% indicates that MDAs will have to continue for at least another two years. Kassena-Nankana district reduction was from 35.5% at baseline to 5.5% at mid-term, further to 4.0% before year six and 6.6% after year six. The 6.6% mf prevalence being above the required threshold also meant that the programme in the district needed to continue with MDAs. In Builsa district reductions was from baseline of 25.5% to 28.8% which was slightly higher after three years of MDAs, then to 3.4% before year six and 10.2% after year six. Reductions in Builsa being inconsistent and ending with 10.2% therefore required further MDAs. Sissala district started with a baseline of 31.0%, moving down to 10.0%, but had no surveys undertaken before year six, however surveys undertaken after year six indicated a reduction to 3.1% (Figure 6.5), though MDAs have to continue.

It was noted that for each of these start-up districts with the exception of Sissala, there was an increase in prevalence from the pre-year six assessments to the post-year six assessments. The reason being that efforts were made to improve on the sample sizes employed for the surveys by moving into adjacent communities to ensure that the recommended sample size of 500 was achieved or sample size obtained was close to 500. This provided a better picture of the mf prevalence within these programme districts by increasing the power of the surveys.

Generally downward trends have been in observed in the second set of districts that joined the programme. Trends were also observed in districts that were at various stages of programme implementation with regards to the number of years of MDAs undertaken. A study of the second set of districts where the programme up-scaled included Wa, Lawra, Jirapa and Nadowli, all in the Upper West region all of which belonged to the second set of districts that joined the programme to eliminate LF. Wa district had started with a baseline of 21.0% to 19.0% at mid-term and finally to 12.9% after five years of MDA. Lawra has started with 20.0% at baseline, with marginal reduction to

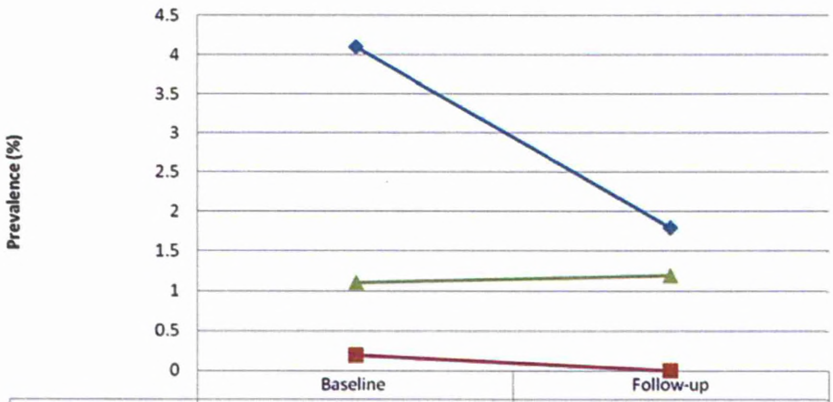
19.0% at mid-term and then finally to 5% after the fifth MDA. Jirapa and Nadowli on the other hand experienced a rise from a baseline of 15.2% and 4.0% respectively to 28.1% and 17.0% respectively and finally reducing to 11.0% and 0.4% respectively (Figure 6.6). Again the sample sizes applied for the surveys from baseline to the mid-term surveys where the programme made the effort to ensure meeting the required sample sizes must have accounted for the slight marginal reductions seen with Wa and Lawra districts and a rise in mf prevalence seen with Jirapa and Nadowli districts from baseline to mid-term. However, all the four districts demonstrated reductions in mf prevalence post year five MDA, though all but Nadowli (0.4%) have prevalence levels more than 1%. The programme can therefore proceed with further surveys and analysis, which might provide evidence for MDAs to stop in Nadowli district.

Similar downward trends have been observed among the third set of districts that joined the programme in its up-scaling plan. These include Bawku East and West districts, which used to be a single district at the onset of the programme. These districts only have baseline and mid-term prevalence data for demonstration of trends in microfilaria prevalence. Bawku East and West districts had baseline prevalence of 4.1% which declined to 1.8% on follow up, East Mamprusi had a baseline prevalence of 0.2% which dropped further to 0% and West Mamprusi which had a baseline prevalence of 1.1% obtained a follow up prevalence of approximately 1.2% (Figure 6.7). This demonstrates trends in mf prevalence of districts which did not have significantly high prevalence levels at the onset of the programme and hence the decision to start implementation of MDAs much later in the up-scaling plan of the programme. After three rounds of annual MDA most of the districts in this category had achieved LF parasite prevalence levels, which might enable the programme to proceed with TAS to determine if transmission has been broken. East Mamprusi having attained this prevalence level requires sentinel and cross-check site analysis to help further demonstrate the need to proceed with further TAS that might lead to the decision to stop treatment.

6.5 Conclusions

Generally, microfilaria prevalence and other immuno-parasitologic indicators have shown significant downward trends in all districts on the programme. Microfilaria prevalence surveys were undertaken in spite of funding and logistic challenges. However technical challenges with the use of the ICT card antigen tests together with challenges of their availability reduced the value of antigen tests in programmatic decision-making.

Figure 6.7: Observed Trends in MF Prevalence among Selected Districts from Third Set of Districts Joining the Programme



	Baseline	Follow-up
Bawku East/West	4.1	1.8
East Mamprusi	0.2	0
West Mamprusi	1.1	1.19

The first five start up districts have also made significant progress in the reduction of microfilarial prevalence, however the high prevalence obtained in previous studies undertaken prior to the inception of the programme and at baseline might explain the difficulty in reducing mf prevalence below the required 1% that would lead to a break in transmission in spite of initial rapid falls in prevalence following the initiation of MDA. However, the possibility of this occurring has been demonstrated by Awutu-Efutu-Senya district, which has reached the end point of MDA and will be moving into surveillance mode for two years. This will be discussed under the chapter on determining the endpoint of MDA.

Many districts particularly in the Northern region and Agona in the Central Region which started implementing MDA later in the up-scaling process have been able to reduce their microfilaria prevalence to less than 1% and need to undertake the TAS to determine the end point while noting that end point determination has been successfully undertaken in Agona district together with Awutu-Efutu-Senya district as one evaluation unit. Again this will also be discussed in the chapter on determining the end point of MDA.

In conclusion the recommended 5-6 years required to break the transmission of LF needs to be reviewed through further operational research with evidence presently available from the Ghana LF Elimination Programme. The number of years required to break transmission of LF seems to depend on the microfilaraemia prevalence at inception of the programme. It is important to note here that the role of other confounding factors in particular therapeutic coverage and compliance with MDA (Ottesen et al, 2008; Talbot et al, 2008; Cantey et al, 2010; Hodges et al, 2010), geographical coverage, mosquito vector characteristics, drug regimens (Bockarie et al, 2009) and other factors important to the successful implementation of LF elimination. These need to be considered in the process of monitoring and evaluation of MDA programmes (Kyelem et al, 2003, Addis, 2010). All these factors are important and integral to the achievement of elimination of LF.

Chapter 7

Determining the End Points of Mass Drug Administration for Lymphatic Filariasis in Ghana

Chapter 7: Determining the End Points of Mass Drug Administration for Lymphatic Filariasis in Ghana

7.1 Introduction

Elimination programmes have a life span and therefore at the outset of the GPELF based on experiences in provinces of countries such as China that had been successful in eliminating LF (Xu et al, 2011) it was proposed that a period of between 5-6 years of annual treatments with ivermectin and albendazole was required to ensure elimination of LF from endemic areas after institution of treatment with coverage of circa 65% (Ottesen et al 1997; Ottesen, 2006). It was hypothesized that interruption of transmission could be achieved if prevalence of microfilaraemia declined below 1%, based on the China experience (Xu et al, 2011, Sudomo et al, 2010).

In the WHO 2001 LF report, to interrupt transmission of *W.bancrofti* was defined as "reduction in the disease incidence to close to zero as a result of deliberate efforts requiring continued and coordinated activities" (WHO, 2001). This meant that the entire at-risk population had to be covered with MDA over a time period long enough to bring about the desired effect of interrupting transmission. The drugs that were recommended were DEC (6mg/kg) and albendazole (400mg) or ivermectin (150ug/kg) and albendazole (400mg). DEC -fortified cooking salt daily over a period of 6-12 months is another option that is available to endemic countries (Ottesen, 2006, 1995). The GPELF works on the premise that the mass application of anti-filarial drugs is able to reduce microfilaria prevalence below a threshold necessary for continuing transmission of the infection by the local mosquito vector (Molyneux and Zagaria 2002; Ottesen, 2000). This introduces the need for sensitive, specific and standardized laboratory tools to help quantify the burden of infection within communities. Assessing progress and determining the end points of LF elimination programmes require effective laboratory diagnostic tools. Several tools have been developed to help programmes undertake these vital programme assessments. These tools include Bm14 antibody test for antifilarial IgG4, Og4C3 antigen tests and ICT tests for Circulating Filarial Antigens (CFA) and night blood smears for microfilaraemia, which remains the Gold Standard for lymphatic microfilaraemia diagnosis (Weil et al, 2007, Moore et al, 1990).

The GPELF mainly employs two diagnostic tools which are detection of microfilaria (mf) in blood and detection of circulating filarial antigen (CFA) to implement its elimination strategy. CFA is detected by ICT rapid test and Og4C3 ELISA tests. These tests are useful when the parasite prevalence is relatively high but their sensitivity at low mf prevalence raises concern particularly in determining the end point of MDA and in the post-MDA surveillance phase (Weil et al, 2007, Happatz et al, 2008). End points determination and post-MDA surveillance for LF elimination programmes requires sensitive and reliable diagnostic tools to accurately define these end points and future surveillance (Hayley et al, 2010). A negative antibody serology test in children is a good indicator for cessation of transmission (Hayley et al, 2010). Hayley et al were able to demonstrate that filter paper sampling method was a sensitive and specific alternative to collection of blood collection surveys ((Hayley et al, 2010).

The Bm14 antibody tests are capable of detecting recent exposure to infective larvae and the presence of adult worms but the antigen and antibody tests are highly specific for LF with minimal to no cross-reactivity for other helminths which co-exist in populations where LF is endemic (Tisch et al, 2008). Antibody tests for monitoring LF infections was not useful in the past as individuals in endemic areas were constantly exposed to the infection and therefore antibody positive (Weil et al, 2007) but they could be useful tests in determining end points and in post-MDA surveillance in determining transmission among children born after the institution of MDA (Weil et al, 2007). There are commercially available recombinant antigen detection tests with improved specificity due to reduced cross-reactivity with other parasitic diseases (Lammie et al, 2004). This made it a potential LF diagnostic test (Dissanayake et al, 1992).

Even though blood smears for detection of microfilaraemia is the essential parasitological method for establishing infection, antigen and antibody tests have also been shown to have several advantages over blood smears for the detection of microfilaraemia (Weil et al, 1996, 1997, 2007). These tests are sensitive and do not require night blood sampling in *W.bancrofti* endemic areas where microfilaraemia have nocturnal periodicity (Turner et al, 1993). It is noteworthy that Og4C3 antigens on which the ELISA (More et al, 1990) and ICT card test (Weil at al, 1997) are based is secreted by W. bancofti adult worms but not by Brugia species (Tisch et al, 2008). The Bm14 antibodies on the other hand may be present in individuals with *W. bancrofti*, *B. malayi*, or *B. timori* infection (Lammie et al, 2004).

Joseph et al (2010) clearly demonstrated the applicability of filter paper sampling method for detection of antifilarial IgG4 antibodies using the Filariasis CELISA. They indicated that this method was a feasible alternative for sero-epidemiological surveys. The filter paper sampling method is cost-effective, easy to undertake with limited sample variation resulting from changes in temperature since the blood spots are stable when completely dried at room temperature for up to a week (Coltorti et al, 1988). It is sensitive and has the added benefit of being applicable for post-MDA surveillance of LF (Joseph et al, 2010).

Tisch et al (2008) established that the IgG4 antibody to Bm14 is a good indicator for monitoring ongoing and recent transmission in children as sentinel groups (Tisch et al, 2008) in comparison to antigenemia which has the tendency to persist for months to years after the administration of anti-filarial drugs (Tisch et al, 2008). They determined the relationship between participation in MDA and changes in LF infection indicators and concluded that IgG4 antibody to Bm14 was a better indicator for monitoring the progress and possibly detect recrudescence or persisting transmission of *W. bancrofti* after MDA has ceased. Several years of annual treatments with anti-filarial medicines had resulted in marked reduction in microfilarial prevalence with less marked change to antibody and antigen rates (Tisch et al, 2008). However, these infection indicators continued to decline even after five years of stopping MDA with Bm14 antibodies persisting in the greatest proportions (Tisch et al, 2008). The Bm14 antibody tests could therefore be used as adequately sensitive tests for monitoring continuing transmission before and after MDA aimed at eliminating transmission of LF (Tisch et al, 2008).

For the detection of *W.bancrofti* infection, diagnostics for circulating Og3C4 antigen and IgG4 antibody to the recombinant LF protein designated Bm14 are employed. These tests are used for mapping LF endemic communities and are also applied to determine interruption of transmission (Lammie et al, 2004, Ottesen, 2006). TropBio antigen enzyme-linked immunosorbent assay (ELISA) and the immunochromatographic (ICT) test rapid-card tests are commercially available diagnostic tests for the detection of LF infections in individuals (Melrose et al). In Ghana bancroftian filariasis is caused by *W.bancrofti* (Gyapong et al, 1996; Gyapong et al 2000; Boakye et al, 2004; Gbakima et al, 2005) which also occurs in many tropical and sub-tropical areas and accounts for 90% of cases of LF infection (Turner et al, 1993).

The Gold Standard for the diagnosis of LF is the detection of microfilaraemia in blood samples (Moore et al, 1990). The use of this test has been the practice for research in LF, though it is often insensitive at low microfilaraemia densities (Moore et al, 1990). The need to collect the blood specimen at night makes the test less acceptable by community members and even the health workers (Moore et al, 1990). Many cases of active disease may also be amicrofilaraemia and therefore using microfilaraemia detection as an estimate of disease burden is bound to lead to an underestimation of the level of infection. (Moore et al, 1990; Ramzy et al, 2006; Ottesen et al, 2006; Farid et al, 2007).

Circulating filarial antigen (CFA) enzyme-linked immunosorbent assays (ELISA) were introduced in the early 1990s [Moore et al, 1990] and the immunochromatographic test (ICT) rapid card test for CFA in the mid-1990s (Wiel et al, 1997). These tests have transformed the diagnosis of bancroftian filariasis. The tests are sensitive, specific, not affected by periodicity and are capable of detecting both microfilaraemic and amicrofilaraemic cases (Moore et al, 1990; Simonsen et al, 1997; Ramzy et al, 2006; Ottesen et al, 2006; Farid et al, 2007; Weil et al, 2008; Weil et al, 2012). It is easy to perform on the field and requires little training for its application. It is user friendly and the preferred method for mapping LF disease endemicity (Molyneux and Zagaria 2002; Gyapong et al 2002). The cost of the ICT card test, the need for it to be read within 10 minutes in the field and need for cold storage also presents significant challenges with its usage and economic accessibility to elimination programmes. ELISA tests for the detection of filarial antigens and antibodies, though cumbersome have remained an alternative to ICT tests for the diagnosis of filariasis and also for use in assessing interruption of transmission (Melrose et al, 2004) while investigations on the most appropriate diagnostic tests for determining the end points of MDA progresses (Weil et al, 2012) .

The Ghana Filariasis Elimination Programme (GFEP) was established with the aim of providing ivermectin and albendazole to all its endemic districts for the elimination of LF. This has been done through a gradual up-scaling process since 2000. By the year 2006 all the implementation units or districts endemic for LF in Ghana had started MDA and the 5 start-up districts had completed the minimum of 5-6 rounds of annual MDA (Ottesen, 2006, Ottesen et al 1997). All LF endemic districts have therefore completed between 5 and 10 rounds of annual MDA by 2010. Significant reductions in microfilaria prevalence had been recorded from the longitudinal blood surveys undertaken on the programme to eliminate the disease in Ghana. The challenge was therefore to find the evidence that elimination of LF had been achieved in these endemic districts as a demonstration of the ultimate success of the programme. The GFEP set but missed the year 2010 as the target for elimination of LF (Strategic Plan,Ghana Filariasis Elimination Programme, 2000) and also marked the midpoint of the GAELF that has an elimination target of 2020 (Addiss, 2010).

The GPELF has identified two important challenges to the elimination of LF which included the need for verifying elimination of LF and post-MDA surveillance (Addiss, 2010). The decision on when to stop treatment in Ghana became a challenging one since operational research conducted in Ghana has been inadequate to determine this. Surveys to develop, test and sharpen the tools for determining the end point of MDA were needed. With technical and financial support of the Bill and Melinda Gates Foundation, the Atlanta LF Support Centre and the Africa LF Support Centre based in Accra together with other countries a multi-country operational research activity was initiated in an attempt to develop and test the tools required for making this determination. The process involved refining technical definitions for assessing programme success, identifying determinants of success, identification of interventions that could be applied to supplement the current strategies of MDA were identified to be inadequate for achieving interruption of transmission. The development of guidelines to guide the process for implementing countries that had undertaken the minimum number of annual rounds of MDA was imperative (Addiss, 2010).

The elimination targets of LF involves achieving 5-6 rounds of annual treatments or MDA with ivermectin and albendazole in countries co-endemic for LF and onchocerciasis like Ghana and DEC and albendazole for countries that are only endemic for LF. Community microfilaria prevalence should also be reduced to below 1% among the adult population and antigen prevalence among children less than 5 years of age should be 0% according to WHO's Monitoring and Evaluation manual (WHO, 2000, A Guideline for Programme Managers references). The initial WHO guidelines for determining the end points of MDA for programmes was defined by an antigen prevalence rate of less than one in 3000 children born after the initiation of MDA was required to stop MDA in an endemic district (WHO, 2005).

In Ghana there is the urgent need to scale down the elimination programme in order to free up the limited resources available for the implementation of the NTDs Programme from districts that have achieved elimination. The evidence to inform this process is urgently needed. A study to determine the most effective method for monitoring transmission of *W.bancrofti* and to determine the end point of MDAs was undertaken. These surveys were also employed by the programme to provide the evidence for stopping MDA in districts that met these criteria.

Current WHO Guidelines on how to determine national LF elimination program endpoints and for establishing post-MDA surveillance are based on diagnostic tools developed in 1999 (Addiss, 2010). Several diagnostic tests based on detection of human antibodies to recombinant antigens in blood and urine, parasite DNA circulating DNA in human blood or vector mosquitoes has been developed (Weil GJ et al, 2007). Studies were undertaken to first identify the most useful diagnostic tools for determining the end points in a Phase I study. ICT for antigen tests for children aged 6-7 years instead of those under 5 years, blood smears for microfilaraemia among adults and PCR for circulating DNA tests were identified as useful tools for this purpose (Phase I Report for Ghana Studies, Unpublished). The process ended with the development of a new WHO standard protocol for determining the end point of MDA. Phase II studies were conducted to test the identified tools. The Phase II survey's main aim was to test the new WHO standard protocol for determining the end point of MDA in 4 districts in Ghana. These districts are Efutu, Awutu-Senya and Agona East and West districts and had satisfied the criteria for proceeding with surveys to stop MDA. As part of this study important research questions within the framework of determining the end point of MDA were also addressed, however these will not be discussed in this thesis.

LF is targeted for elimination by the year 2020 through MDA, using a single dose combination of ivermectin and albendazole or DEC and albendazole for a period of 5-6 years. Many countries are reaching the target treatment cycles of 5-6 years MDA and the decision to stop needs to be addressed. To ensure the ultimate success of the GPELF, studies to find solutions to the challenges and potential barriers facing it today were funded by the Bill and Melinda Gates Foundation.

This study has passed through a first phase the purpose of which was to compare all available diagnostics to identify which would be most programmatically useful for the GPELF. This phase showed that ICT to detect antigen in children aged between 6-7 years is a practical tool that will help countries to decide when to stop MDA. The purpose of the present phase II study is to apply these tools to determine the end points of MDAs in selected sites.

The main aim of this survey was to test the new WHO standard protocol for determining the end point of MDA in 4 districts in Ghana. These districts are Efutu, Awutu-Senya and Agona East and West districts and had satisfied the criteria for proceeding with surveys to stop MDA.

7.2 Assessing Interruption of Transmission of Lymphatic Filariasis in Five Start-up Districts

In an effort to determine interruption of LF transmission in Ghana Og4C3 and the Bm14 test were applied. Antigen and antibody assays were performed on blood spots collected from children borne since the inception of MDAs. The antigen and antibody status of children born during this period most of whom are aged 1-6 years and who resided in the study communities for at least a year before this cross-sectional study to determine the appearance of any new infection was conducted. Most of these communities are high transmission communities where MDAs were first initiated at the inception of the programme in 2000/2001. Having achieved more than 6 annual rounds of treatment in the 5 study districts in Ghana and in many other districts an objective to determine the end point of MDA in these districts was undertaken. Specifically this study sought to undertake an assessment for new infections in children born since the commencement of annual mass treatments. By employing the available epidemiological assessment tools and methods the end point of this mass treatment programme could be estimated.

7.3 Method

ELISA tests that rely on the principle of antigen-antibody reactions in the body were applied. Filarial parasite antigens are proteins which enter the human body and induce production of antibodies as part of the body's immune response to the antigens. These antigens are found on the surface of the parasites and are recognized by the body to produce the antibodies, which bind to the specific antigens on the parasites in order to eliminate the antigens from the body as part of the body's immune response to infections. Though all antigens may be cleared during this process some of the antibodies may remain in the body's circulatory system for up to 6 months during which they remain detectable after which time they are eliminated by the body. Positive antigen reactions are indicative of active infections while positive antibody reactions may be indicative of active or recent infections and ongoing transmission.

7.3.1 BM14 Antibody and OG4C3 Antigen Tests

Bm14 antibody and Og4C3 antigen tests can be employed to detect the presence or absence of *W.bancrofti* antigens in infected or exposed individuals. Og4C3 antigen tests are capable of detecting *W. bancrofti* antigens while Bm14 tests are able to detect the presence of antibodies to *W. bancrofti* antigens in blood. Detection of antigens of *W. bancrofti* in blood employs the use of specific *W. bancrofti* antibody coated microtitre plates, which capture the antigens in the blood of affected individuals. Further reaction by titration of the complex with a substrate through attached enzymes presents as a colour change, which is measured as the absorbance of the solution. Similarly detection of the *W. bancrofti* antibodies in blood employs *W. bancrofti* antigen coated microtitre plates which are capable of capturing the antibodies in the blood. This is capable of also reacting with a substrate through an enzyme-linked process to present as a colour change measured as the absorbance of the final solution. The absorbance based on the colour intensity of the solution is proportional to the amount of antigens or antibodies detected or present in the blood sample. The higher the absorbance the more antigens or antibodies are detectable in a particular sample. A positive test for *W. bancrofti* antigen (Og4C3) is interpreted as an active infection. A positive Bm14 test is interpreted as exposure to the infection.

Positive tests for antigens and antibodies give high absorbance due to high titers because more molecules of *W.bancrofti* antigens or antibodies are present to bind to the antigens or antibodies respectively in the solution. Negative tests therefore indicate the absence of antigens or antibodies in the blood to bring about the positive reaction. These are based on the cut-off points for the titre values or absorbance, which fall between the positive and negative values. Absorbance values too high to be negative or too low to be positive were repeated to confirm the obtained positive or negative results. In such a situation, these samples were repeated to confirm positivity or negativity. In other cases the actual values were used depending on how far or close these values were to the negative or positive cut-off points. Since all the samples tested came from endemic areas that had reached the point of a possible break in transmission, intermediate or indeterminate results were considered as negative test results.

7.4 Results and Discussion of OG4C3 Antigen and BM14 Antibody Tests

These cross-sectional TAS employed the Og3C4 antigen and Bm14 antibody ELISA tests. About 300 blood samples were targeted per site and collected from children from 2 sentinel and 1 cross-check site from each of the 5 districts. A total of 4,550 blood samples were collected and about 60µl of finger prick blood used to prepare a blood spot on filter paper. These spots were dried and stored below zero degrees in a cold room. Og4C3 antigen and Bm14 antibody tests were performed on these blood spots and analysis of the data carried out.

In all a total of 4112 Og4C3 antigen and 3888 Bm14 antibody tests were carried out. However, out of this total number, 259 (6.3%) of these Og4C3 antigen test results were indeterminate while 788 (20.3%) of the Bm14 antibody test results were indeterminate. These test results were therefore discarded as being negative. A total of 36 of the Og4C3 antigen test results were positive giving an overall antigen prevalence rate of 0.9% among the children surveyed from the 5 endemic districts while the Bm14 antibody prevalence rate was 9.7% with 376 positive test results (Table 7.1). The Og4C3 antigen and Bm14 antibody tests could not be done on 438 and 670 of the samples respectively due to wastage of the test kits during the laboratory process. Analysis of the data is therefore based on 4112 samples processed for Og4C3 antigen and 3888 processed for Bm14 antibody.

Each of the districts had an Og4C3 antigen positive rate below 1% except Builsa district, which had a positive of 2.1% (Table 7.2), which is significantly high since no new infections are expected within this age group. Higher Bm14 antibody prevalence rates were found in all sampled districts and these ranged from 8.1% in Sissala district to 13.1% in Kassena Nankana district. Builsa district had the highest number of positives recorded but because more people were tested Builsa had a Bm14 antibody prevalence rate of 11.2% (Table 7.3). These results indicate that though prevalence of the active infection was low as indicated by the Og3C3 antigen tests results exposure to the parasites as indicated by the Bm14 antibody tests was significant at the district level.

At the sub-district level, the Bm14 antibody test results ranged from 4.6% in Dixcove sub-district in the Ahanta West district with the highest of 22.2% in Paga in the Kassena Nankana district. The other sub-districts of Kassena Nankana also generally had high values of 31.2% and 11.8% (Table 7.4) in Kassena Nankana Central and Navrongo respectively. This further emphasizes the level of exposure at the sub-district level, which may be indicative of recent exposure or ongoing or active infection, or a recently cured individual. In the case of these surveys these sampled children have not be exposed to treatment with ivermectin and albendazole to date and so these prevalence levels of antibodies to *W.bancrofti* would indicate recent or active infection.

Individuals positive for the antigens are expected to be positive for the antibodies as well. However, very recent infections might not have generated enough antibodies to be detectable by ELISA. A person may also be positive for the antibody test but negative for the antigen test.

Table 7.1: Summary of OG4C3 Antigen and BM14 Antibody Test Results

SUMMARY TABLE OF OG4C3 AND BM14 TEST RESULTS							
Test Undertaken	**Total Tested**	**Number Positive**	**Positive %**	**Number Negative**	**Negative %**	**Indeterminate (N)**	**Indeterminate %**
OG4C3	4112	36	0.9	3819	92.9	259	6.3
BM14	3888	376	9.7	2726	70.1	788	20.3

Table 7.2: Summary of OG4C3 Antigen Test Results by Districts

BM14 RESULTS BY DISTRICTS							
District	**Total Tested**	**Number Positive**	**Positive (%)**	**Number Negative**	**Negative (%)**	**Indeterminate**	**Indeterminate (%)**
AES	526	43	8.2	351	66.7	131	24.9
Builsa	1036	116	11.2	705	68.1	215	20.8
KND	528	69	13.1	399	75.6	60	11.4
Sissala	851	69	8.1	612	71.9	173	20.3
Ahanta West	947	79	8.3	659	69.6	209	22.1
Total	3888	376	9.7	2726	70.1	788	20.3

Table 7.3: Summary of BM14 Antibody Test Results by Districts

OG4C3 Test Results by Districts							
District	**Total Tested**	**Number Positive**	**Positive %**	**Number Negative**	**Negative %**	**Indeterminate (N)**	**Indeterminate %**
AWUTU EFUTU SENYA	900	3	0.3	843	93.7	54	6.0
Builsa	851	18	2.1	782	91.9	51	6.0
KND	681	5	0.7	637	93.5	41	6.0
Sissala	948	4	0.4	863	91.0	81	8.5
Ahanta West	732	6	0.8	694	94.8	32	4.4
TOTAL	4112	36	0.9	3819	92.9	259	6.3

Figure7.1: OG4C3 Antigen and BM14 Antibody Test Results Among Children

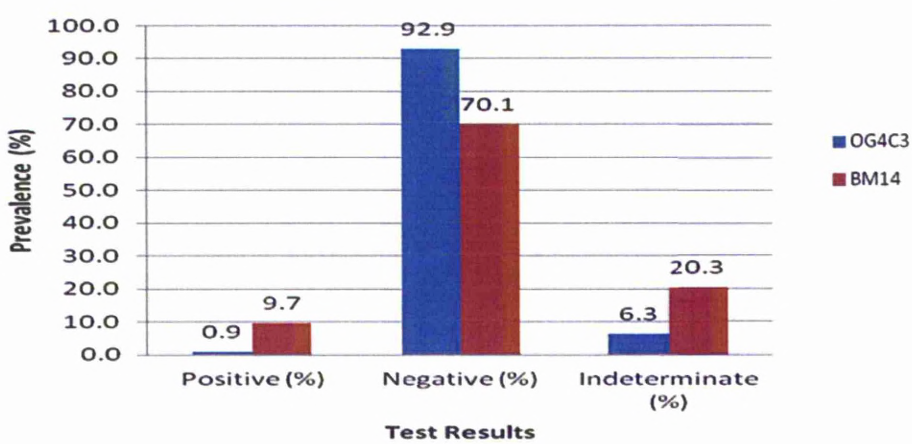


Figure 7.2: OG4C3 Antigen Test Results by Districts

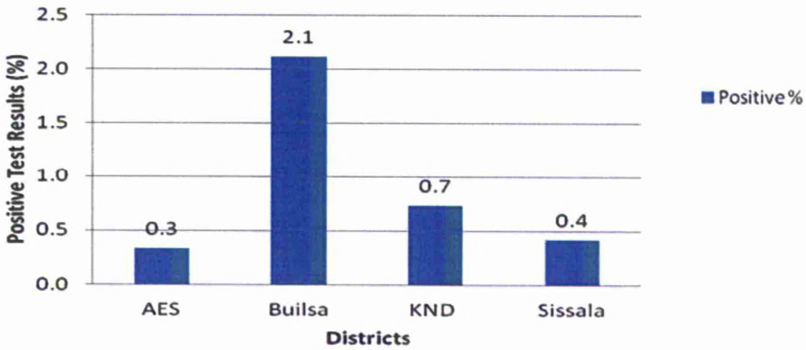
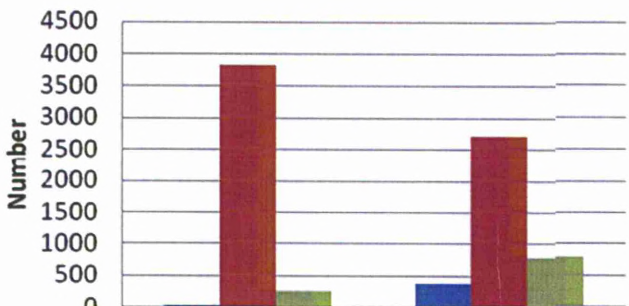


Figure 7.3: Summary OG4C3 Antigen and BM14 Antibody Test Results



	OG4C3	BM14
Positive (N)	36	376
Negative (N)	3819	2726
Indeterminate (N)	259	788

Figure 7.4: BM14 Antibody Test Results by District

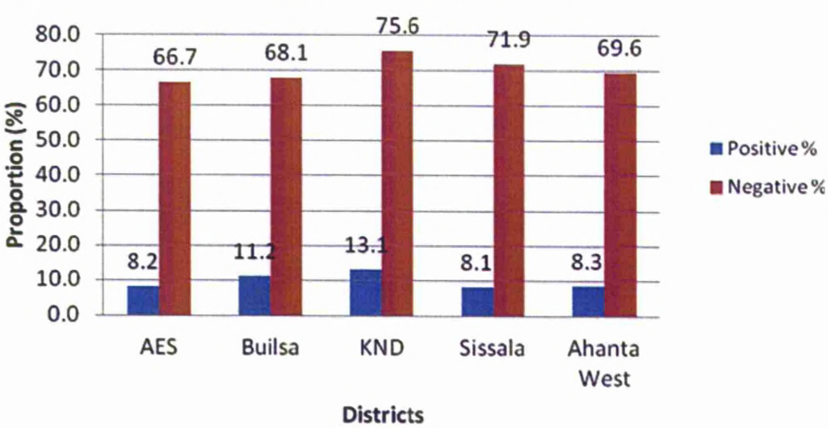


Figure 7.5: BM14 Antibody Prevalence by District

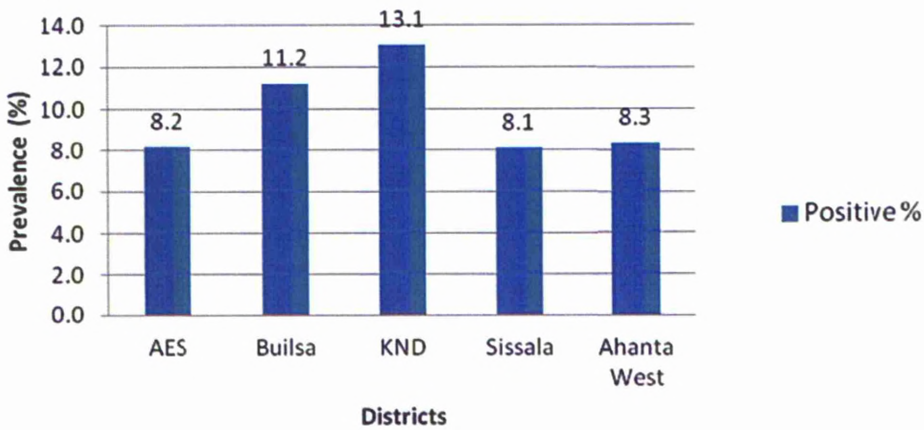


Table 7.4: Summary of BM14 Antibody Test Results by Sub-Districts

No	Region	District	Sub-districts	BM14 BY SUB-DISTRICTS						
				Total Tested	Number Positive	Positive %	Number Negative	Negative %	Indeterminate	Indeterminate (%)
1	Central	Awutu Senya	Bontrase	35	4	11.4	22	62.9	8	22.9
2		Efutu Municipal	Winneba	491	39	7.9	329	67.0	123	25.1
3	Upper East	Builsa	Chuchuluga	370	28	7.6	292	78.9	50	13.5
4			Fumbisi	343	39	11.4	234	68.2	70	20.4
5			Wiaga	323	49	15.2	179	55.4	95	29.4
6	Upper East	KND	Central South	68	9	13.2	50	73.5	9	13.2
7			Navrongo	406	48	11.8	315	77.6	43	10.6
8		KND South	Paga	54	12	22.2	34	63.0	8	14.8
9	Upper West	Sissala East	Gwollu	178	11	6.2	133	74.7	34	19.1
10			Jeffisi	226	21	9.3	147	65.0	58	25.7
11		Sissala West	Kunchugu	447	37	8.3	332	74.3	81	18.1
12	Western	Ahanta West	Agona	251	16	6.4	188	74.9	47	18.7
13			Apowa	370	39	10.5	241	65.1	90	24.3
14			Dixcove	239	20	8.4	159	66.5	60	25.1
15			Dixcove	87	4	4.6	71	81.6	12	13.8
	Total			3888	376	9.7	2726	70.1	788	20.3

Table 7.5: Summary of OG4C3 Antigen Test Results by Sub-Districts

No.	Region	District	Sub-districts	OG4C3 BY SUB-DISTRICTS						
				Total Tested	Number Positive	Positive %	Number Negative	Negative %	Indeterminate (N)	Indeterminate %
1	Central	Awutu Senya	Bontrase	188	0	0.0	181	96.3	7	3.7
2		Efutu Municipal	Winneba	712	3	0.4	662	93.0	47	6.6
3	Upper East	Builsa	Chuchuluga	367	4	1.1	340	92.6	23	6.3
4			Fumbisi	127	2	1.6	118	92.9	7	5.5
5			Wiaga	357	12	3.4	324	90.8	21	5.9
6	Upper East	KND	Central South	68	0	0.0	64	94.1	4	5.9
7			Navrongo	390	2	0.5	378	96.9	12	3.1
8		KND South	Paga	223	3	1.3	195	87.4	25	11.2
9	Upper West	Sissala East	Gwollu	262	0	0.0	243	92.7	19	7.3
10			Jeffisi	285	1	0.4	235	82.5	49	17.2
11		Sissala West	Kunchugu	401	3	0.7	385	96.0	13	3.2
12	Western	Ahanta West	Agona	211	0	0.0	210	99.5	1	0.5
13			Apowa	319	4	1.3	286	89.7	29	9.1
14			Dixcove	115	2	1.7	111	96.5	2	1.7
15			Dixcove	87	0	0.0	87	100.0	0	0.0
	Total			4112	36	0.9	3819	92.9	259	6.3

Figure 7.6: OG4C3 Antigen Test Results by Sub-Districts

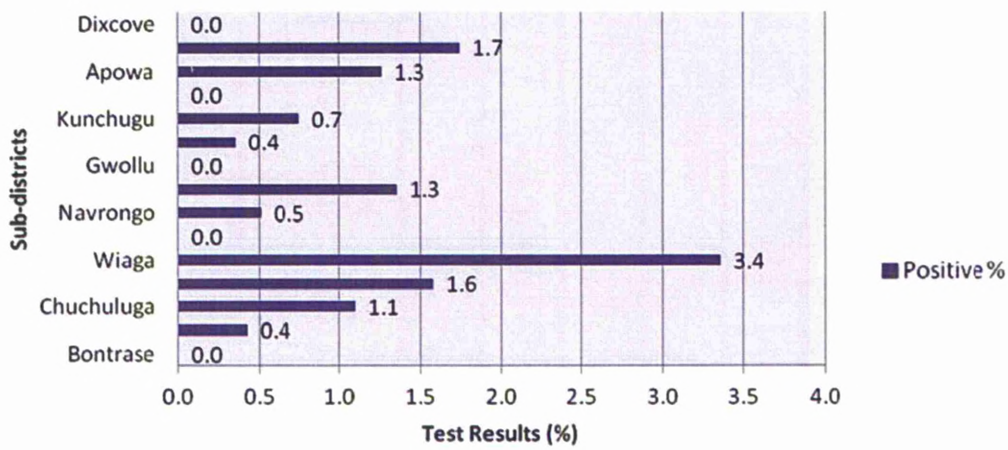


Figure 7.7: BM14 Antigen Test Results by Sub-District

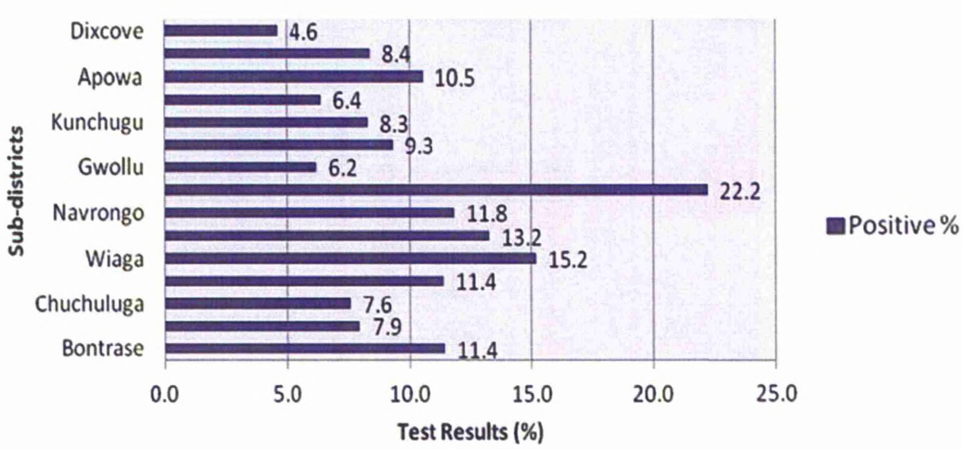


Table 7.6: OG4C3 Antigen Test Results by Sites (Communities)

No	Region	District	Sub-districts	Sentinel	OG4C3 Antigen TEST RESULTS						
					Total Tested (N)	Number Positive	Positive (%)	Number Negative (N)	Negative (%)	Indeterminate (N)	Indeterminate (%)
1	Central	Awutu Senya	Bontrase	BONTRASE	188	0	0.0	181	96.3	7	3.7
2	Central	Efutu Municipal	Winneba	ESSUEKYIR	712	3	0.4	662	93.0	47	6.6
3	Upper East	Builsa	Chuchuluga	NAMONSA	367	4	1.1	340	92.6	23	6.3
4	Upper East	Builsa	Fumbisi	FARINSA	127	2	1.6	118	92.9	7	5.5
5	Upper East	Builsa	Wiaga	CHIOK 2	357	12	3.4	324	90.8	21	5.9
6	Upper East	KND	Central South	Korania	68	0	0.0	64	94.1	4	5.9
7	Upper East	KND	Navrongo	NAMOLO	390	2	0.5	378	96.9	12	3.1
8	Upper East	KND South	Paga	BADUNU	223	3	1.3	195	87.4	25	11.2
9	Upper East	Sissala East	Gwollu	SORBELLE	262	0	0.0	243	92.7	19	7.3
10	Upper East	Sissala East	Jeffisi	DASIMA	285	1	0.4	235	82.5	49	17.2
11	Upper West	Sissala West	Kunchugu	BASSISAN	401	3	0.7	385	96.0	13	3.2
12	Western	Ahanta West	Agona	ABURA	211	0	0.0	210	99.5	1	0.5
13	Western	Ahanta West	Apowa	ASEMKOW	319	4	1.3	286	89.7	29	9.1
14	Western	Ahanta West	Dixcove	BUSUA	115	2	1.7	111	96.5	2	1.7
15	Western	Ahanta West	Dixcove	EGYAMBRA	87	0	0.0	87	100.0	0	0.0
Total					4112	36	0.9	3819	92.9	259	6.3

Table 7.7: BM14 Antibody Test Results by Sites (Communities)

No.	Region	District	Sub-districts	Sentinel	BM14 TEST RESULTS						
					Total Tested	Number Positive (N)	Positive (%)	Number Negative (N)	Negative (%)	Indeterminate (N)	Indeterminate (%)
1	Central	Awutu Senya	Bontrase	Bontrase	35	4	11.4	22	62.9	8	22.9
2	Central	Efutu Municipal	Winneba	Essuekyir	491	39	7.9	329	67.0	123	25.1
3	Upper East	Builsa	Chuchuluga	Namonsa	370	28	7.6	292	78.9	50	13.5
4	Upper East	Builsa	Fumbisi	Farinsa	343	39	11.4	234	68.2	70	20.4
5	Upper East	Builsa	Wiaga	Chiok 2	323	49	15.2	179	55.4	95	29.4
6	Upper East	KND	Central South	Korania	68	9	13.2	50	73.5	9	13.2
7	Upper East	KND	Navrongo	Namolo	406	48	11.8	315	77.6	43	10.6
8	Upper East	KND South	Paga	Badunu	54	12	22.2	34	63.0	8	14.8
9	Upper East	Sissala East	Gwollu	Sorbelle	178	11	6.2	133	74.7	34	19.1
10	Upper East	Sissala East	Jeffisi	Dasima	226	21	9.3	147	65.0	58	25.7
11	Upper West	Sissala West	Kunchugu	Bassisan	447	37	8.3	332	74.3	81	18.1
12	Western	Ahanta West	Agona	Abura	251	16	6.4	188	74.9	47	18.7
13	Western	Ahanta West	Apowa	Asemkow	370	39	10.5	241	65.1	90	24.3
14	Western	Ahanta West	Dixcove	Busua	239	20	8.4	159	66.5	60	25.1
15	Western	Ahanta West	Dixcove	Egyambra	87	4	4.6	71	81.6	12	13.8
Total					3888	376	9.7	2726	70.1	788	20.3

The antigen prevalence rates were generally lower than the antibody prevalence rates among children surveyed (Figure 7.1). Og4C3 antigen tests conducted on children gave results that showed a low prevalence of antigen in the children surveyed in these sentinel and cross-check sites. At the sub-district level antigen prevalence rates were from 0.0% in several of the sub-districts to 1.7% in Discove in Ahanta West district (Table 7.5). The sites, which had 0% prevalence rates, were located in Bontrase sub-district in Awutu-Efutu-Senya districts and KND Central in Kassena Nankana, Gwollu in Sissala, Agona and Discove sub-districts in Ahanta West. (Table 7.5) Based on these test results none of the districts qualified to stop MDAs since antigen prevalence in both sentinel and cross-check sites which is indicative of active infection was not 0% in all the 5 start-up districts surveyed. None of the districts could demonstrate a prevalence level of 0% in both sentinel and cross-check sites surveyed to indicate a break in the transmission of *W. bancrofti*.

7.5 Method for Testing the Stopping Criteria for Lymphatic Filariasis

Districts enroled for these assessments needed to meet the selection criteria. As an entry criteria districts or implementation units should have completed 5 rounds of effective MDA and also have microfilaria prevalence from sentinel and spot check sites of less than 1% among the adult population. For this study the concept of the evaluation unit was also introduced which incorporated several implementation units or districts with similar characteristics in terms of number of completed rounds of MDA and microfilaraemia prevalence of less than 1% from both sentinel and cross check sites as a single unit for the evaluation (WHO, 2000; WHO, 2006, a,b; WHO, 2011a). For this survey the selected evaluation unit (EU) was made up of Awutu-Efutu-Senya, and Agona districts (Figure 7.8) in the Central Region recently re-demarcated into 4 districts (Government of Ghana, 2006) were identified for the study. The microfilaraemia prevalence in the selected districts for the Ghana study from the 3 monitored sentinel and cross-check sites at the last or post-MDA 5 survey were 0.9%, 0.9% and 0.2% respectively and had completed 7 and 8 rounds of MDA respectively. In Awutu-Efutu-Senya district the microfilaraemia prevalence at baseline before MDA ranged from 12.5% to 27.1% and between 0.0% and 2.9% at mid-term. In Agona district microfilaraemia baseline prevalence was between 0.0% and 13.8% and 1.3% before MDA 5.

The total population of the evaluation unit was 388,424 made up of Awutu-Efutu-Senya district with 200,717 and Agona with 187,707. The school aged population defined as children of school-going age who have been enrolled into school and receiving formal education for Awutu Efutu Senya district was about 54,796 and that for Agona was 51,167 which is 27.3% of the total population. School enrolment was 73,007 for AES and 64,948 for Agona. These were the actual figures for both public and private schools in both districts. There were 807 schools made up of 281 public and 526 private schools and the school enrolment was therefore more than 75%. Awutu Eutu Senya district had completed 9 rounds of MDA while Agona district had completed 8 rounds as at 2009. Both districts have completed 8 rounds of MDA and the reported coverage for each year is shown in the table 7.8 below.

Table 8: Reported MDA Coverage from 2001-2009 for Awutu Efutu Senya and Agona Districts

MDA Coverage (%) for Awutu-Efutu-Senya and Agona									
Districts	**Year**								
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Awutu Efutu Senya	87.7	93.1	76.7	82.4	75.9	84.2	79.2	62.2	57.9
Agona	-	91.7	85.1	87.6	76	77	88.1	87.9	75.6

During this treatment period from 2001 to 2009 Awutu Eutu Senya had achieved adequate MDA coverage of between 88.1% and 70.2% from 2001 to 2008. However, in 2009 the reported coverage by Awutu Eutu Senya was 44.6% (Table 7.8), which is below the 65.0% threshold. The reasons for this low reported coverage in 2009 need further investigations, however the district was still considered for the TAS. Agona district reported coverage that ranged from 69.1% - 88.0% (Table 8). For the years 2008 and 2009 the district populations and population treated for the newly created districts in Agona and Awutu-Afutu-Senya districts were combined to give the treatment coverage for the districts.

Some 30 schools were randomly selected using the "Survey Sample Builder" software application. This was increased to 40 in order to obtain the required sample size of the age group 6-7 years due to the timing of the surveys. The communities in which the schools were located or communities which the schools served,were chosen for the community survey. Children aged 6-7 years old and adults 16-45 years of age from the evaluation unit made up of Awutu-Efutu-Senya and Agona districts were surveyed. The school children were surveyed first. The cluster-sample school survey of children in class one and two (children aged 6-7 years) was applied. This involved the selection of a 1556 school children from 40 schools in the evaluation unit.

Adult sampling was done after the school participants have been sampled in communities where the school children live. Sampling of individuals or households for both school children and adults was done randomly. Immunochromatographic card tests (ICT) were performed on all study participants and positive individuals from both cohorts had follow-up PCR and microfilaraemia tests conducted on blood samples collected from them within 14 days of the initial ICT test.

The Standard Operating Procedures (SOPs) for blood collection and processing for analyses (LF Support Center, The Taskforce for Child Survival and Development, 2009) were employed for the surveys. Data analysis was done in Excel. Collection of day-time blood from school children aged six and seven years was undertaken in the selected schools. Parental consent was sought before blood collection was done. For the community survey, house-to-house registration of study participants was undertaken and day-time blood samples taken for processing in two Government hospital laboratories located in the study districts. In the field, blood was collected into Ethylene Diamine Tetra Acetic Acid (EDTA) coated tubes for transportation to the laboratory. In the laboratory, the blood collected in the EDTA tubes were processed as follows; ICT tests were done on each sample and the results recorded following the manufacturer's instructions. A second ICT test was done on any sample that showed positive or indeterminate result for the first ICT. The study participant was then followed up and night blood collection was done. Blood films for microfilariae (microfilaraemia) identification with whole blood were prepared. Also, blood blots were made on filter papers and dried 24 hours. All procedures were undertaken according to the SOPs provided for the study.

7.5.1 Core (Children) Survey

The core survey was employed to test the stopping criteria. A school-based cluster survey was employed in this study. School children in classes one and two aged between six and seven years were selected and included in the study. In instances where school children aged between six and seven years were found in classes other than classes one and two, they were also recruited into the study. The Manual for Survey Planners and the Survey Sample Builder application were used in calculating the sample size for the study. The target sample size was 1556 school children from a target of 30 later increased to 40 schools. No sampling interval was utilized because a major limitation of the study was that schools had just re-opened in the rural areas and the likelihood of getting more than 50% of the children in school was small. Thus all children aged between six and 7 years in the schools were sampled. ICT antigen tests were performed on all persons sampled and positive test individuals followed up with blood smears for microfilaraemia and PCR tests.

7.5.2 Adult Survey

This survey also employed Awutu-Efutu-Senya and Agona districts as the evaluation unit. This was also a cross-sectional survey, which employed adults' aged between 16 and 45 years selected from communities, which the selected schools served. The calculated study sample was 900, however a sample size of 1200 was applied to improve on the power of the study. Each community in which the schools were located were divided into 4 quadrants and 10 adults randomly selected from different households in each of the quadrants to make a total of 40 per community from each of the communities from which the initial 30 schools were found.

Diagnostic tests and sample processing was the same as that carried out in the core survey. ICT antigen tests were performed on all persons sampled and positive test individuals followed up with blood smears for microfilaraemia and PCR tests.

7.5.3 Ethical Considerations

Ethical clearance was sought from the Ghana Health Service Ethical Review Board and from the Liverpool School of Tropical Medicine. The consent of the heads of the selected schools and the parents of the selected children were sought before any sample was taken. For the adult survey, the consent of the participating adults was sought before blood was drawn.

7.5.4 Results and Discussions

Core Survey was employed to test the MDA stopping criteria that had been developed in the Phase I study. For the core survey involving school children aged 6-7 years, a total of 1577 were involved in the study selected from 40 schools with a total school enrolment of 14,023 (Table 7.9). About 11% (Table 7.9) of the total school enrolment was therefore employed for the survey. About 687 (43.6 %) of the total sample size were children aged six years while 879 (55.7 %) were aged 7. The number of female children recruited into the survey was 817 (52 %), while the boys were 760 (48 %) (Table 7.10). There was no record of age for 11 (0.7 %) of the children surveyed (Table 7.10).

Table 7.9: Sample Size Overview

IU or District	Number of Schools Surveyed	Total Enrolment or Population	Number of Children Surveyed	Proportion (%) of Children Surveyed
Awutu-Efutu-Senya	26	9,723	1,122	12%
Agona	14	4,300	455	11.%
Total (n=)	40	14,023	1,577	11%

Table 7.10: Demographic Information

Age (Years)	Male	Female	Total
6	330	357	687 (43.6%)
7	421	458	879 (55.7%)
No age recorded	9	2	11 (0.7%)
Total (n=)	760 (48%)	817 (52%)	1577

For the whole survey only 2 children tested positive for ICT antigenaemia giving an antigen prevalence of about 0.1% (Table 7.11). These tests repeated positive for the ICT, while PCR result was negative and no microfilaraemia was detected on blood smear. In all therefore there was no sample that tested positive for both PCR and blood smear, none was blood film positive and PCR negative nor microfilaraemia positive with PCR and blood smear positive or PCR or blood smear positive (Table 7.11 and 7.12).

Table 7.11: Test Results for Children's Survey

Test Result	**1st ICT**	**2nd ICT**	**PCR**	**Blood Smear**	**Microfilaraemia (PCR and Blood Smear)**	**PCR (+) and Blood Smear (-)**	**Blood Smear (+) and PCR (-)**	**Any Microfilaraemia + (PCR and/or Blood Smear)**
Positive	2/1562 (0.13%)	2/2 (100%)	0/2 (0%)	0/2 (0%)	0/2	0/2	0/2	0/2
Negative	1558/1562 (99.7&)	0/2 (0%)	-	-	-	-	-	-
Invalid	1/1562 (0.06%)	0/2 (0%)	-	-	-	-	-	-
Not tested	1/1562 (0.06%)	0/2 (0%)	-	-	-	-	-	-
Total	1562	2	2	2	2	2	2	2

Table 7.12: Cross-Comparison Test Results for Children's Survey (for ICT)

Test	Index n=	ICT	PCR	Blood Smear	Microfilaraemia (PCR or Blood Smear)
ICT	1562	2/1562 (0.13%)	0/2 (0%)	0/2 (0%)	0/2 (0%)
PCR	2	2/2 (100%)	0/2 (0%)	0/2 (0%)	-
Blood Smear	2	2/2 (100%)	0/2 (0%)	0/2 (0%)	-
Microfilaraemia (PCR or Blood Smear and/or Microfilaraemia Positive)	2	2/2 (100%)	0/2 (0%)	0/2 (0%)	0/2 (0%)

Table 7.13: Discordant Test Results

Test	ICT Results	PCR Results	Blood Smear	Number (n)
Results	Positive	Negative	Negative	2
Total Discordant Results (n=)				2

Two discordant test results were obtained and these were the two children that tested positive for ICT antigenaemia but negative for PCR and blood smear examination (Table 7.12 and 7.13). These discordant results indicate that actual prevalence of infection based is about 0% since the antigen positivity could not be confirmed by blood smear which is a less sensitive test than the ICT test . Neither could this antigen positivity be confirmed by PCR which is a more sensitive test than the antigen tests though repeated ICT tests came out positive.

7.6.1 Results of Adult Surveys

Table 7.14: Demographic Information

Age	Male	Female	Total
16-20 years	110	155	265 (22%)
21-25 years	77	175	252 (21%)
26-30 years	61	177	238 (20%)
31-35 years	42	129	171 (14%)
36-40 years	34	114	148 (12%)
41-45 years	32	91	123 (10%)
No age recorded	4	5	9 (0.7%)
Total (n=)	360 (30%)	846(70%)	1206

Table 7.15: Results for All Tests

Test Result	1st ICT	2nd ICT	PCR	Blood Smear	Microfilaraemia (PCR and Blood Smear	PCR (+) and Blood Smear (-)	Blood Smear (+) and PCR (-)	Any Microfilaraemia+ (PCR and/or Blood Smear)*
Positive	14/1199	14/14	1/14	0/10	0/14	0/14	0/14	1/14
Negative	1184/1199	0/14	13/14	10/10	10/14	-	-	13/14
Invalid	0/1199	0/14	0/14	0/10	0/14	-	-	-
Not tested	1/1199	0/14	0/14	0/10	0/14	-	-	-
Total	1199	14	14	10	14	14	14	14

Table 7.16: Cross-Comparison Test Results For ICT and/or Microfilaraemia positive for Adult Surveys

Test	Index n=	ICT	PCR	Blood Smear	Microfilaraemia (PCR or Blood Smear)
ICT	1199	14/1199	1/14	0/14	1/14
PCR	14	14/14	1/14	0/14	-
Blood Smear	10	10/10	0/10	0/10	-
Mf (PCR or Blood Smear)	1/14	14/14	1/14	0/14	1/14

Table 7.17: Discordant Test Results for Adult Surveys

	ICT Result	PCR	Blood Smear	n=
1	Positive	Positive	No Result	1
2	Positive	Negative	Negative	10
3	Positive	Negative	No Result	3
Total Discordant Results (n=)				14

The adult survey involving a total sample size of 1206 had the age group from 16-20 years forming the biggest proportion of 22% (Table 7.14). The age group participation in the survey declined with ascending age. This ended with the age range of 41-45 having the least number recruited into the study. About 0.7% made up of 9 individuals had no age recorded for the adult surveys (Table 7.14).

Results of the ICT, PCR and blood smear for microfilaraemia tests conducted on blood samples collected for the adults surveys indicated 14 positives for both first and repeat ICT tests. Of this number only one was PCR positive and none blood smear positive (Table 7.15). All the 14 tests can be categorized as being discordant (Table 7.16 and 7.17) since none of the positive tests for ICT card antigen test was positive for neither PCR nor blood smear for microfilaraemia. Among the 14 positive test results for ICT, one was PCR positive but microfilaraemia negative.

More girls than boys were recruited into the study. This is probably because at the primary level school enrolment for girls tends to be higher than that for boys (GDHS, 2003 and 2008; GHSS, 2000 and 2010). While for the adult population there was a decline in the proportion of adults recruited as the age range increased which also is in accordance with the population pyramid for the country (GGDHS, 2003 and 2008; GHSS, 2000 and 2010). More adult females were also sampled as compared to the adult males for the adult surveys, primarily because adult men leave the communities during the day to involve themselves in income generating activities leaving the women at home to cater for the children and other household needs including household chores. Women engaged in income generating activities tend to be located within the communities in which they reside.

Blood antigenaemia prevalence detection by the ICT card tests indicated an antigen prevalence of 0.1% among the 6-7 year old school children surveyed. However, this could not be confirmed with blood smear tests for microfilaraemia, which is the known gold standard test for LF infection in terms of sensitivity although the sensitivity of blood examination could be increased if blood filtration of a larger volume of blood through Nucleopore filters is employed (Ramzy et al, 2006). However in the settings in which this study was done this was not practicable. However the results are indicative of extremely low prevalence, and one, which should not sustain transmission although it does suggest that some transmission among children who were born after the inception of the LF treatment programme in the surveyed districts did take place.

The adult population had an ICT antigen prevalence of 1.2% suggesting higher infection rates among adults as compared to the 6-7 year old children. Adults are generally more exposed to mosquito bites than children considering that adult activities such as late sleeping habits, household chores and night entertainment predispose adults to more mosquito bites at night. However, in terms of the transmission dynamics of LF, adults might also have had a longer period of exposure with some adults not complying with mass treatment being reservoir of infection of the disease.

The low prevalence of *W. bancrofti* demonstrated by these surveys does demonstrate a possible break in transmission in these endemic districts surveyed as one evaluation unit. However, the need for post-elimination surveillance with the purpose of monitoring re-emergence of LF as has been shown in other programmes in India and recently in Zanzibar (Mohammed, 2009) may raise the questions as to whether the evidence provided through these surveys are adequate to inform the decision to bring MDAs to an end.

Generally TAS have not included vector infectivity studies. Programmes have also not routinely monitored transmission of LF with vector studies. The main reasons have probably been due to lack of the required expertise to undertake this monitoring as part of routine programme activities. The role of the mosquito vector in the transmission of *W. bancrofti* and therefore the vector-parasite relationship is extremely important as some vectors have been demonstrated to be effectively transmitting LF even at low prevalence of the parasite. Vector-parasite dynamics and therefore vector infectivity should be considered in providing evidence to demonstrate interruption of transmission of filaria parasites.

The success of any LF elimination programmes is demonstrated by the decision to stop treatment. The ability to effectively monitor the disease and eventually take a decision to stop treatment depends on the availability of tools to make this determination. Current working hypothesis is premised on the China experience that transmission will be interrupted if microfilariaemia prevalence falls to less than 1% (Itoh et al., 2007; Addiss and the GAELF, 2010). This recommended threshold might have to be reconsidered based on country experience requiring thresholds determined by factors such as the vector species, parasite type, drug regimen and treatment compliance.

In the light of the above discussion it can be concluded that overall prevalence of filaria parasites is low as demonstrated by the ICT card tests being the only one of the tools that produced positive test results. The results from the core school children study recommend that MDA be stopped, post MDA surveillance should be put in place in these 4 districts and a re-assessment of transmission carried out after two years

The antigen positive rate shown by the ICT card tests in the light of negative microfilariaemia may be explained the presence of residual adult worm antigens present in human circulation from resolved infections (Lammie et al., 1994) which may persist for as long as 3 years post treatment due to slow clearance from the circulation (Eberhard et al. 1997; Nicholas et al., 1997; Tisch et al., 2008).

7.7 Conclusions

Conclusions based on the results of the two surveys conducted in 2007 involving the five start up districts using the filter paper method and then in 2010 involving one evaluation unit made up of 2 districts that included one of the 5 start up districts respectively are made. Transmission assessment surveys using the filter paper method conducted on the five start up districts in 2007 demonstrated ongoing transmission of filarial infection requiring that MDA be continued in the five start up districts which included Awutu-Efutu-Senya district. Subsequent surveys in 2010 involving Awutu-Efutu-Senya district as part of testing the WHO's stopping criteria established that transmission in this district as part of an evaluation unit assessed had been broken. These 2010 surveys conducted indicated that ICT prevalence in the community was very low (1.0%). All slides examined for W.bancrofti were negative. The annual MDA in Awutu-Senya, Efutu, Agona East and Agona West has been effective and MDA could be discontinued and a 2-year post MDA surveillance undertaken after which a re-assessment of transmission could be carried out.

These surveys have indicated that 5-6 years of MDA are not adequate to reduce microfilaraemia prevalence in Ghana to less than 1% for all the study districts according to the Og4C3 and Bm14 ELISA tests undertaken among the children less than six years in the five start up districts. High prevalence of infection in these districts at the outset of the programme could be the factor which is the most likely explanation for this situation. In these districts MDA coverage and compliance, discussed in chapter 4, though good according to reports received on the programme, might not be a true reflection of the MDA coverage on the ground. Urbanization, which is fast spreading in Ghana, presents many challenges to mass drug treatment programmes. These start-up districts include many urban communities, which may have contributed to possible inadequate compliance with treatment among discrepancies with the calculation of coverage. Ghana employs ivermectin and albendazole for its MDA but compared to DEC and albendazole this treatment regimen might be less efficacious (Gyapong et al, 2005; Bockarie et al, 2009).

After a further two years of mass drug treatment, Awutu-Efutu-Senya district together with Agona district as a single evaluation unit has been able to interrupt transmission. This suggests that more than the 5-6 years would be required for other districts to interrupt transmission of *W. bancrofti* in Ghana. However, districts which started with a lower baseline prevalence than these 5 districts but have undertaken the minimum of 5-6 rounds of MDA should have TAS undertaken which could lead to discontinuation of MDA in these districts.

Resources available could be deployed to focus on the challenge of reducing prevalence in those districts with higher prevalence at baseline.

Operational research and programme experience indicate that, when five years of MDA are insufficient to reduce microfilaremia to levels that will not sustain further transmission, several factors may be in play. These include high prevalence and density of pre-MDA microfilaremia, low drug coverage or compliance, characteristics of the local vector, the drug regimen used, or other factors, such as the lack of social cohesion, especially in urban environments. In such situations, alternative strategies may be needed, including modified drug regimens (e.g., biannual MDA), vector control measures, or perhaps antibiotic treatment. The study demonstrated that LF elimination is feasible, even in areas with the greatest challenges, however continued operational research is necessary for providing guidance to programmes (Addiss, 2010).

Chapter 8

Initiating a Schistosomiasis and Soil-Transmitted Helminth Control Programme in Ghana-rationale, approaches and results

Chapter 8: Initiating a Schistosomiasis and Soil-Transmitted Helminth Control Programme in Ghana-rationale, approaches and results

8.1 Introduction

Ghana started implementing the National Neglected Tropical Diseases Programme (NTDP) in 2007 developing a 2-Year Plan of Work and receiving approval for the United States Agency for International Development (USAID) funded project. The disease control programmes that were incorporated into the plan were LF Elimination, Onchocerciasis Control, Trachoma Control and Schistosomiasis and Soil Transmitted Helminthiasis Programmes. The Filariasis Control Programme had completed mapping and was implementing the programme in all identified 61 endemic districts. The Onchocerciasis Control Programme had incomplete risk maps but despite that was also implementing the programme in 3204 communities from 66 endemic districts, Trachoma control was implementing the SAFE (Surgery, Antibiotics, Face washing and Environmental Control) strategy in its programme in 26 endemic districts after undertaking a mapping exercise. Data available from hospital and Health Centre records had indicated that Soil Transmitted Helminthiasis was endemic throughout the country and did not necessarily require a mapping exercise. Schistosomiasis, required to be mapped in order to focus control activities and to prevent wastage of resources. Stool samples collected for identifying Schistosoma mansoni was also used to identify soil transmitted helminths to serve as baseline data for monitoroing helminths infection.

Schistosomiasis is a water-borne disease of significant global public health importance (Steinmann et al., 2006) endemic in tropical and subtropical regions with fresh water snails acting as intermediate hosts. The infection is widespread in parts of Africa, South America, the Middle East, the Caribbean and Asia where it is a leading cause of morbidity and mortality (WHO, 2002; WHO, 2010). Schistosomiasis is confined to the tropics and subtropics and mainly affects the poorer segments of the population. The disease exhibits a focal distribution due to the dependence of the parasites on snail hosts (Lengeler, et al., 2002; Hotez et al, 2009). Communities where schistosomiasis is found exhibit characteristics common to neglected populations. They are poor rural and urban settings which are usually underserved with basic social amenities and marginalised in particular access to safe water, sanitation and health education. Despite the high burden of the disease its control has not hitherto been prioritised in the national policy or political agenda (Hotez et al. 2008).

The disease is a major cause of morbidity and mortality. Estimates indicate that about 779 million people are at risk of schistosomiasis and 207 million people are infected with the disease. About 20 million people of those infected with the condition are estimated to have the severe form of the disease (Chitsulu et al, 2000). Schistosomiasis is ranked only next to malaria and LF globally as a parasitic disease in terms the estimated at risk population and the number of people infected with the disease. It is again estimated to cause an annual loss of between 1.7 and 4.5 million disability adjusted life years (DALYS) (WHO,2010; WHO, 2004; WHO 2002; Utzinger et al., 2004) though the global disease burden of schistosomiasis is suspected to have been seriously underestimated since other estimates have shown that this figure could even be much higher (King CH et al, 2005). Sub-saharan Africa has the highest burden of schistosomiasis where the highest prevalence and intensities of infection are found in school-aged children, adolescents and young adults (Woolhouse, 1998;Jordan et al., 1993). In sub-saharan Africa the negative impact of this infection on school performance seriously undermines social and economic development in heavily infected areas (Tanner, 1989; Weisbrod et al,1973; Nokes et al, 1999; Parker , 1992).

Transmission of schistosomiasis has strong linkages to the development, provision and management of water resources in the tropics and sub-tropics, where transmission is either introduced or increased if already present as well as development of water and sanitation and knowledge (Hunter et al., 1993; Jobin, 1999; Oomen et al., 1988; Oomen et al., 1988). With regards to the at-risk population an estimated 660 million were concentrated in Africa from 46 countries with 201.5 million estimated to be carrying schistosome eggs. The African region alone accounts for some 97% of the total number of infections worldwide and 87% of the global burden (Steinmann P et al, 2006).

8.2 Disease Causation, Transmission, Pathogenesis and Pathology

The disease causation, transmission, pathogenesis and pathology including the complications of schistosomiasis are well known and documented (Fenwick et al, 2006). Schistosomiasis is caused by schistosomes, which are parasitic trematode worms with five main species infecting humans. These are *Schistosoma mansoni*, *S.japonicum*, *S. mekongi*, *S. guiniensis* (formerly *S. intercalatum*), and *S.haematobium* (WHO, 2007). Transmission of schistosomiasis in Africa is mainly by *S. mansoni* and *S. haematobium*, though *S. guineansis* may be found in the rain forest areas of Central African Republic and Cameroon and into Congo and Democratic Republic of the Congo.

This human infection is mainly acquired through direct contact with freshwater infected with the larva of the parasite. The larvae also called cercariae penetrate the skin and then shed their tails to become schistosomula leading to localised dermatitis at the site of entry of the infected individual which eventually leads to the 3 broad categories of the disease manifestation which are allergic dermatitis, acute schistosomiasis and chronic schistosomiasis (Schwartz et al, 2000). An intermediate snail host of the genus specific to

Schistosoma species is required to complete the transmission of schistosomiasis determines the distribution of the parasite.

Schistosomiasis has the ability to cause acute and chronic morbidity among those infected. The acute form of the disease occurs 14-84 days after contact with contaminated water. The clinical presentation of acute schistosomiasis includes fever, headache, generalized myalgia, right-upper quadrant pain and bloody diarrhoea. *S. mansoni* infected individuals may also present with respiratory symptoms. Chronic schistosomiasis generally presents pathologies linked to the gastrointestinal, the hepatic, and the neurologic, and/or genitourinary systems. The adult schistosome worms live in inside the hosts for many years inducing an immune response in the host to the schistosome eggs (WHO, 2007). Accumulation of the eggs is mostly found in the intestine and the liver for *S mansoni* and genitourinary tract for *S. haematobium*. Neural pathologies may result when schistosome eggs accumulate in the host's central nervous system. Higher prevalence of epilepsy and transverse myelitis are observed in communities where schistosomiasis is highly endemic ((Strickland et al, 1991; Davis, 1996)).

The venous system of the human host houses the sexual stage of the female schistosoma parasite while the asexual stage is found in the intermediate freshwater snail. The sexual stages mate in the peripheral system of the human host and ovideposit in the portal circulation of the liver. The ova are deposited in the veins of the urinary bladder and the ureters in the case of *S. haematobium* while S. mansoni ova become deposited in the tributaries of the inferior mesenteric veins(Strickland et al, 1991; Davis, 1996). The distinguishing features of the ova are a terminal spine for the eggs of *S. haematobium* while that of *S. mansoni* has a lateral spine. These ova are produced and deposited within 4-6 weeks of penetration of the skin by the cercariae. Eggs enter the lumen of peripheral organs from where they are finally expelled externally through urine or stool. The ova that that are not expelled reach distant organs often the liver, lungs and sometimes the central nervous system. The morbidity and prognosis of each infection is determined by quantity of ova that are produced. Miracidia develop in the ova, and when these reach fresh water they emerge from their eggs at a suitable temperature they hatch into the water and search for the snail intermediate host which are *Biomphalaria* and *Bulinus* for *S. mansoni* and *S. haematobium* respectively (Strickland et al, 1991; Davis, 1996). Miracidia enter the snail hosts within 24 hours and undergo a complex cycle of asexual development which results in the release of hundreds of cercariae into water in 3-5 weeks. Failure to find a definitive host results in the death of cercariae in 2-3 days. In the definitive host the cercariae after penetration through the skin are called schistomules which migrate through the circulatory system of tissues of the heart, lungs and then the liver where they mature, mate and start the process of ovidepositing within 4-6 weeks of piercing the skin (Strickland et al., 1991; Davis, 1996).

The different stages of schistosome parasites elicit different clinical signs and symptoms. During penetration of the skin cercariae induce an allergic inflammatory reactions resulting in lesions called cercarial dermatitis characterized by itching and erythema formation. This reaction is exaggerated among visitors to an endemic area while indigenes rarely manifest this reaction, (Ahmed Ali El-Garem, 1998). As the schistosomules migrate through the hemolymphatic system of the heart and lungs especially in heavy infections, allergic reactions characterized by cough, fever and sometimes haemoptysis called larval pneumonitis occur. These may be accompanied by lymphadenopathy and hepatosplenic enlargement which occur as a reaction to antigens produced by the growing parasite (El-Garem 1998).

The adult worm is capable of living for up to 5-7 years in the human host without eliciting serious pathological effects. However, antigens produced and excreted from the gut of the adult parasite helps in the immunological diagnosis of positive cases and can also be used as an indication of the therapeutic response to treatment (Simpson et al, 1985). Antibodies produced in response to these antigens can also be used as indicators of the infection however once produced infected patients maintain a positive reaction for life even after successful treatment (Mott et al, 1982).

Antigen-antibody immune complexes formed in infected individuals are responsible for other disease manifestations. Acute stages of the infection due to oviposition can result in patients experiencing prolonged fever, rigors, sweating, myalgia and headache accompanied by urticarial rash, generalized lymphadenopathy and hepatosplenomegaly. Anorexia, nausea, abdominal discomfort and diarrhea with mucus or blood may also be experienced occasionally. When the soluble immune complexes are deposited in the glomeruli of the kidneys there is glomerulopathy especially in the case of S. haematobium infection (Barsoum et al., 1979).

Complications of schistosomiasis may be severe and life threatening. Urogenital signs and symptoms are common in *S. haematobium* with possible complications of bladder cancer and chronic obstructive renal failure (El-Garem, 1998).

Intestinal schistosomiasis due to *S. mansoni* infection may present with severe abdominal pains and production of bloody muco-purulent with polyp formation in complicated cases (Cheever et al., 1978) Cardiopulmonary schistosomiasis, larval pneumonitis, reactionary pneumonitis and Schistosomal Cor pulmonale are all presentations of schistosomiasis (Strickland et al., 1991). Hepatic (Hepato-Splenic) schistosomiasis characterised by hepatic and sometimes splenic enlargement may result in the complications of liver cirrhosis (Symmers, 1904). Ectopic schistosomiasis results mainly from lesions in the brain and spinal cord, skin, eyes and other organs. Ova reach these ectopic sites via vascular connections. Such pathology is focal and generalized seizures, headache, optic field defects and speech abnormalities may be met with in cerebral schistosomiasis while transverse myelitis with paraplegia may point to spinal affection (Strickland et al, 1991).

8.3 Control Strategies and Global Initiatives and Partnerships

The WHO strategy for schistosomiasis control focuses on reducing disease through periodic, targeted treatment with praziquantel WHO PCT (WHO, 2007). Strategies for the control of the disease though also well known have suffered some setbacks in its implementation especially in Africa including Ghana. Significant is the need for proper mapping of the disease in endemic countries to guide implementation of control strategies. In Ghana some attempts have been made in the past to describe the epidemiology of schistosomiasis in some selected areas of interest to particular research scientists including the Volta Basin Project but these studies were insufficient to guide the implementation of a countrywide control programme. The need for this countrywide mapping of schistosomiasis became urgent with the inception of the integrated control programme for NTDs in Ghana.

The availability and use of praziquantel together with socio-economic development evident by improved water supply and sanitation have contributed to a decrease in the infected and at risk populations for schistosomiasis. However, in many areas water resource development projects have contributed to improvements in socio-economic status in Africa including in Ghana, but are associated with a simultaneous increase in the risk of infection with schistosomiasis (Southgate et al., 1997; Steinmann et al, 2006). In Ghana these water resource development projects are the Volta

Lake, Kpong dam and other smaller irrigation dams in the Upper East region (Hunter, 1990). It is also estimated that 106 million people making some 13.6% of the total at-risk population for schistosomiasis actually live in close proximity to large dam reservoirs and irrigation schemes with three-fifths actually being closely associated with irrigation schemes (Steinmann et al, 2006). Data have shown that in Cote d'Ivoire, Ghana, Senegal and Nigeria, introduction or an increase of urinary schistosomiasis prevalence was observed with the creation of large dams, however similar observations could not be made in the case of intestinal schistosomiasis (Southgate et al, 2001, Steinmann et al, 2006). This established policy of water resource development in many developing countries to help improve water supply and agriculture has led to the establishment of many small dams in areas which increase water contact and favour transmission of schistosomiasis (Hunter, 1990, Southgate et al, 2001). Occupations like mining, fishing and farming also increase water contact and are also high risk factors for the spread of schistosomiasis (Atlas of global distribution of schistosomiasis).

There have been several schistosomiasis control initiatives both globally and at the country level. Most of these initiative were driven by the 54th World Health Assembly which in May 2001 passed resolution 54.19 signed by 200 member states to attain by 2010, a minimum target of regularly administering anti-helminthic drugs to between 75% and 100% of all school-aged children at risk of morbidity. With this control strategy emerged in 2006 the term "preventive chemotherapy' which was to be employed to control concurrently multiple neglected tropical diseasesNTDs (WHO, 2006). The need for drug treatment as the main preventive strategy to be complemented by improved access to safe water and improved hygiene and sanitation was pertinent (Utzinger et al, 2003). More importantly school-based control was to be made an integral part of the school health plans of the Ministries of Education (Bundy et al. 2006).

Several partnerships have greatly enhanced the implementation of health programmes in sub-saharan Africa with many successful and focused mass drug distribution programmes guided by mapping data. In Ghana the USAID/NTDCP which had selected Ghana as one of its 5 fast track countries in 2006 to support implementation of MDA had also provided support to ensure countrywide mapping of schistosomiasis with the hope that this would provide up-to-date prevalence data on schistosomiasis to further implementation of MDA with Praziquantel in all areas where needed particularly among the school-age population. The Schistosomiasis Control Initiative with its experience of mapping in several African countries had also supported six countries to also deliver over 40 million treatments against schistosomiasis and soil transmitted helminths (Fenwick et al, 2009) and was selected to provide technical support for this exercise in Ghana. For the successful implementation of this mapping a partnership involving USAID's Neglected Tropical Diseases Control Programme (USAID/NTDCP) (USA), Schistosomiasis Control Initiative (SCI) of the United Kingdom (UK), the Ghana Health Service of the Ministry of Health (GHS/MOH) and the Ghana Education Service and the Ministry of Education (GES/MOE) in Ghana and the selected communities and schools had been absolutely necessary. The country programme was in the lead to provide coordination and leadership. National, regional and district level technical personnel from the health system undertook the field work. This was done to ensure proper integration of the programme right from the outset.

8.4 Schistosomiasis in Ghana

The need for mapping data to guide and direct the treatment for schistosomiasis is essential for planning countrywide control of schistosomiasis. The focal distribution of schistosomiasis (Lengeler et al,2002; Brooker et al, 2009a) requires detailed information on the geographical distribution at local level to prioritise and target treatment to areas most in need (Brooker et al, 2009a) to ensure cost-effectiveness of the control programme since praziquantel is not donated but procured at high cost to donors and countries. Recent data on the distribution, predicted or otherwise, of schistosomiasis which could be used to inform treatment based on WHO guidelines was not readily available. Urinary schistosomiasis in Ghana was first reported in 1895 and intestinal schistosomiasis was identified in 1920. Available historical data, which dates back to the 1970s indicated that urinary schistosomiasis was widespread throughout the country with the Volta basin having a prevalence as high as 80-90% in many communities living along the lake shore. Similarly, the Volta estuary was endemic with infection rates of 6.3% for *S. mansoni* and 76.2% for *S. haematobium*. Generally schistosomiasis was found to be highly endemic within communities located along rivers in all ten regions of Ghana. *Schistosoma haematobium* was known to be present in all regions though Schistosoma mansoni was only found mainly in the north-eastern and south-eastern parts of the country along the borders with Cote d'Ivoire and in the central part of the country. (WHO, 1987).

In 1963 it was estimated that between 15 and 20% of Ghanaians had suffered schistosomiasis infection especially during their childhood years. Prevalence rates have been observed to have increased since 1965 from surveys undertaken along the Volta Lake. These surveys had showed a significant rise in prevalence rates between the two time periods particularly in the Northern region. *Schistosoma haematobium* was found to be endemic below the Akosombo dam and throughout south-eastern Ghana: *S.mansoni*, on the other hand was found only in north-eastern Ghana with overall prevalence being 2.4%. In large areas of Ghana ideal natural conditions which support the development of the snail intermediate hosts of schistosomes are found and are known to have expanded with the creation of the Volta Lake. The intermediate hosts implicated are *B.pfeifferi*, *Bu. globosus* and *Bu.truncatus* which are responsible for the transmission of intestinal and urinary schistosomiasis respectively and therefore show a similar distribution as the types of schistosomiasis whose transmission they are involved in (WHO, 1987).

In a 2006 report, WHO estimated that Ghana had an estimated prevalence of schistosomiasis of 72.5%, in 2003 and therefore placed Ghana into the group of high schistosomiasis prevalence countries where annual praziquantel treatments were recommended for all school-aged children. The school-aged population in 2006 was estimated at 5,686,077. The recommendation was for all these children to be given praziquantel treatment once a year (WHO, 2008). An identified challenge for ensuring treatment of all at-risk school aged population is the low school enrolment rates in some countries including Ghana. In Ghana school enrolment varies from 53.3% in the Northern region to 86.2% in the Ashanti region (GSS, 2009). This necessitates the need to devise methods for reaching out-of-school school-aged populations who may be at greater risk of infection compared to those in school by virtue of their lifestyle which increases their water contact than those in school. Being in school limits the time they can be in contact with water bodies. Mapping, therefore, helps countries to identify high risk groups for treatment as an initial move towards operationalization of a schistosomiasis control programme (Clements et al. 2006, 2008; Brooker et al. 2008). A significant challenge is the possible need to consider treatment for preschool-aged children (Stothard and Gabrielli, 2007) and other high risk groups such as fishermen, car washers and sand harvesters (Melman et al. 2009). All these groups require proper identification and organisation for treatment. Also mass treatment PC with praziquantel needs to be sustained annually for the entire at-risk population for a minimum of 5 years (Hotez et al, 2009) once treatment has been embarked on in order achieve an impact on transmission without going back to the pre-intervention prevalence of infection (Clements et al, 2009).

8.5 The Neglected Tropical Diseases Control and Schistosomiasis Mapping in Ghana

The NTD Control Programme in Ghana has been operational since the January 2007. The programme has implemented MDA in 5 regions of the country with ivermectin and albendazole for LF and Zithromax for trachoma. In addition, the School Health Education Programme (SHEP) has treated school-aged children in all regions of Ghana with Mebendazole for soil-transmitted helminths in February 2007 with the support of UNICEF.

Out of the 5 NTD diseases being controlled together with the strategy of mass chemotherapy in Ghana, LF and Trachoma had undergone countrywide mapping while onchocerciasis has had partial mapping with the details not being mainly available to the programme. Hospital records have confirmed that Soil Transmitted Helminthiasis is endemic throughout Ghana. The absence of countrywide up-to-date data on schistosomiasis in Ghana made it necessary to undertake surveys to update prevalence data as urinary and intestinal schistosomiasis are known to occur widely. The disease therefore needed to be mapped to establish its endemicity and also guide programme implementation. The SCI was identified to provide technical support for the mapping of schistosomiasis in Ghana as implementing partners for the USAID NTD Control programme with the experience of supporting other countries who have conducted similar mapping exercises in various sub-Saharan African countries.

8.6 Objectives

School-based surveys to determine the distribution of schistosomiasis and soil transmitted helminths in Ghana. The main objective of the surveys was to provide empirical data for the geographic distribution of *S. haematobium*, *S. mansoni* and Soil Transmitted Helminths and to produce predictive maps on the prevalence of schistosomiasis and soil transmitted helminths in Ghana. The results of the mapping exercise was to produce maps which stratify the country according to the prevalence of schistosomiasis within 3 categories (above 50%, between 10-50%, below 10%). This information was used to guide schistosomiasis and soil transmitted helminths programme treatment strategies as part of the neglected tropical diseases.

8.7 Method

Parasitological risk mapping involving the collection of parasitological data from a selected number of sample locations which could be extrapolated across a wide geographical area to provide an estimate of what the predicted prevalence of infection will be across that area was applied. The sample locations were schools and a fixed number of children were recruited into the survey. Stool and urine were collected and microscopic examinations undertaken to provide accurate data on the intensity of infection which was incorporated into a model along with information on factors known to be associated with disease distribution, such as rainfall, temperature and altitude applied in order to produce a risk map of schistosomiasis for Ghana. This form of mapping allowed the prediction of levels of infection for both forms of schistosomiasis, as data on both *S. haematobium* and *S. mansoni* (and also soil transmitted helminthiasis) were collected during the surveys.

8.8 The Process Parasitological Mapping in Ghana

The process of mapping schistosomiasis distribution was carried out through a series of steps (SCI, 2007).

8.8.1 Sample Size Calculations and Selection of sample locations

Due to the limited availability of recent data on prevalence within Ghana and the need to have data available to inform treatment decisions across the whole country, a decision was taken to produce a risk map to cover all regions. This required that the number of locations sampled had to capture enough information to be incorporated into the model without losing robustness and allow extrapolation to the whole country. A list of schools throughout the whole country was collected from the School Health Education Programme (SHEP) of the Ghana Education Service (GES) and with support from the spatial epidemiologists sample size calculations and a list of locations for the survey was undertaken.

A sample size of 77 private and public schools representing different locations were selected from 62 out of the total of the old 138 health districts from 9 of the 10 regions in Ghana. Sixty school children were selected from each of the selected schools for the survey (SCI, 2007, Unpublished). The breakdown of the list of schools selected by Region is indicated in the tables below.

The most recent list of all basic (class1-JSS 3) schools in the whole country, which is the geographical survey area for this survey was collected from the Ghana Education Service and applied for the sample size calculation and selection of locations for the purposes of the exercise. This list in exel electronic format served as the sampling frame for this survey. Ghana has an extensive system of water bodies with the Volta Lake being largest artificially created dam for the purpose of generating hydroelectric power. Some stratification was applied in the selection of schools with schools closest to Volta Lake and those in rural settings with water bodies being more likely to be selected. Those schools further away from water bodies and in rural settings were less likely to be selected during this stratification process (Soares et al, 2011). In all 77 schools were selected for survey and from each school 60 children - 30 boys and 30 girls - were randomly selected for sample collection. Each location was geo-referenced as part of the survey.

Table 8.1: Breakdown of number of schools by region

Region	Number (N) of schools Surveyed per Region
Ashanti	8
Brong Ahafo	13
Central	3
Eastern	6
Northern	22
Upper East	4
Upper West	7
Volta	7
Eastern	7
Total	77

Table 8.2: Summary table showing the numbers selected at each level for the survey

Level	Number (N) Selected
Regions	9
Districts	62
Rural School	73
Urban Schools	4
All Schools	77

8.8.2 Data collection, electronic capture and ethical considerations

The data for this study were collated from school-based parasitological surveys conducted in Ghana in 2008. The purpose of the survey was to provide schistosomiasis and soil transmitted helminths mapping information. The process of preparation, mobilisation and undertaking the fieldwork was done to cover the required number of schools in the minimal possible time without compromising the quality of the data collected. Infection data for schistosomiasis was captured as prevalence data, based on the presence of infection alone, and as intensity data, which measures the level of infection in the individuals examined. Data collected from within schools and from children within the schools included parasitological data in addition to actual GPS coordinates of the sampled location.

Stool and urine samples were collected from each child selected and a single urine slide and double Kato-Katz slides prepared from each stool sample. Microscopic reading of the slides was undertaken. Slides were identified as positive, if a single egg could be seen, or the number of eggs present counted to measure the level of infection. Parasite counts were carried out for each positive slide. In addition, information on the levels of STH was also recorded. For S. haematobium infection, intensity counts were obtained through urine filtration.

However, intensity counts, which were considered more accurate and informative, were also applied for this survey. The parasite prevalence and intensities for the different parasites having been calculated they were entered into epi 6 computer database.

As part of the survey, those found to be positive for schistosomiasis were to be treated with praziquantel, however, this could not be done because praziquantel was unavailable. However, mass treatment was planned for school children within all endemic districts. The ethical implication of this is that any positive children still had the opportunity to receive treatment during the MDA. This was timed to ensure that those positive were treated quickly after the surveys. This strategy also enabled the use of the data for monitoring treatment. This also prevented selected children from being treated twice (once during the survey and once during the MDA) which would not be reflective of the treatment programme.

After completion of the field work, the data generated was electronically captured in Epi info 6 and later imported into Microsoft Excel. The output of this step was therefore complete parasitological dataset in electronic format. Further analysis and production of the maps was undertaken with the support of a spatial epidemiologist. Predicted risk maps of schistosomiasis across the whole country were the products.

Ethical approval for the surveys were obtained from the ethical committees in the United Kingdom (St. Mary Hospital Research Ethics Committee, UK), however, in Ghana this activity was considered part of routine operational or implementation activities of the NTDP of the Public Health Division of the Ghana Health Service. The Ghana Education Service provided the permission to undertake these surveys in schools and duly wrote to inform all the selected schools of this planned activityAt the community level, written consent or informed consent did not have to be taken from the parents. Sample collection was considered non-invasive but the identity of the children and results of examination was kept confidential. Prior information was, however, passed through the School Health Education Programme (SHEP) coordinators and the head teachers to the children, the Parent-Teacher

Associations (PTA) and the chiefs and other opinion leaders within the communities. The Chair of the PTA and other interested parents were invited by the team to be present during the sample collection, slide processing and examination under the microscope. They were given the opportunity to ask questions and also to examine positive samples under the microscope. Parents who did not want their children to participate in the survey were to send verbal information through the children or come to the school to inform the authorities themselves to ensure that their children did not participate in the survey. However, most of the parents who reported at the school were there to request that their children were sampled for the survey. Children after being given all the information were also provided with the option not to participate in the survey if they so wished.

8.8.3 Spatial Modelling

Parasitological risk mapping involving the collection of data from a selected number of sample locations which could be extrapolated across a wide geographical area to provide an estimate of what the predicted prevalence of infection was undertaken. The sample locations were schools and a fixed number of children (60) were recruited into the survey for each school visited. During the survey, the geographic location of each school was determined using a handheld global positioning system (GPS). This data used for the production of the predictive and spot maps for Ghana was from 4,445 children from 77 schools.

The output of this spatial modelling undertaken in collaboration with a spatial epidemiologist, was the production of a preliminary and then final stratified risk map of Ghana indicating prevalence of schistosomiasis across the country. Underlying this was the district administrative areas of Ghana.

This form of mapping allowed the prediction of levels of infection for both forms of schistosomiasis, as data on both *S. haematobium* and *S. mansoni* (and also soil transmitted helminths) was collected during the survey. The output was the production of a map, which stratified the country according to the prevalence of schistosomiasis within 4 categories (above 50%, between 30-50%, between 20-10% and below 10%). However this was re-organised into 3 categories (above 50%, between 10-50% and below 10%) to guide mass treatment according to the WHO recommended treatment strategies.

8.9 Presentation of Results and Discussions

The process of establishing a control programme for schistosomiasis and soil transmitted helminths had previously suffered many setbacks. As part of the processes to initiate implementation of the Schistosomiasis and Soil Transmitted Helminths (SSTH) treatment this mapping process was carried out to identify the at-risk population. Products of data management, analysis and modelling included preliminary maps before the development of the final predictive maps (Figures 8.7-8-9).

Ghana has 10 regions; 9 of them were sampled for this survey. Within these 9 regions, a total of 62 districts were sampled and from these 77 schools made up of 73 rural and 4 urban schools were surveyed. Eleven districts had 2 or 3 schools selected from within them.

The main species of schistosomiasis identified during this survey was *S. haematobium* and *S. mansoni* with *S. haematobium* having a much higher prevalence rate of 17.8% nationally as compared to 1.2% for *S. mansoni*. *Schistosoma haematobium* was identified in all the regions but 5 regions had *S. mansoni* identified as well and therefore demonstrated co-endemicity for the two parasites. Out of the 62 districts sampled for the survey, 53(85%) demonstrated *S haematobium* infection and 7(11%) demonstrated *S. mansoni* and *S. haematobium* co-infection. Nine (15%) of the districts had no infection demonstrated for the survey. Of the 77 schools surveyed, 66 (86%) had children with *S. haematobium* infection while 7 making 9% had *S. haematobium* and *S. mansoni* co-infections.

Schistosoma haematobium was identified in samples from 65 schools while *S. mansoni* was identified from 7 schools (Tables 8.1 and 8.2). Co-infection with *S. haematobium* and *S. mansoni* was demonstrated in all 7 schools from where S. mansoni were identified from stool samples. The remaining 70 schools had *S haematobium* identified in 65 of them leaving 5 schools from where neither *S. mansoni* nor *S haematobium* was identified. *Schistosoma haematobium* was identified in 65 schools.

Generally, *S. haematobium* infection was much more prevalent than *S. mansoni*. All *S. mansoni* endemic districts and schools were co-endemic for *S. haematobium*. Nationally the highest school prevalence rate was 98.3% for *S. haematobium* recorded in the Eastern region and 65.5% for *S. mansoni* recorded in the Northern region respectively. The prevalence range was therefore 0.0-98.3% nationally. The highest prevalence was recorded in the Eastern region (98.3%) and the lowest in Brong Ahafo, Central, Northern, Upper West, Volta and Western region. The highest was in the Eastern region followed by Brong Ahafo (95.0%), Upper East (70.0%), Ashanti (68.3%), Northern (55.9%), Upper West (52.7%), Volta (39.0%), Western (36.7%) and then finally the Central (6.7%) regions in decreasing order.

Figure 8.1: *S. haematobium* Prevalence Rates by Region

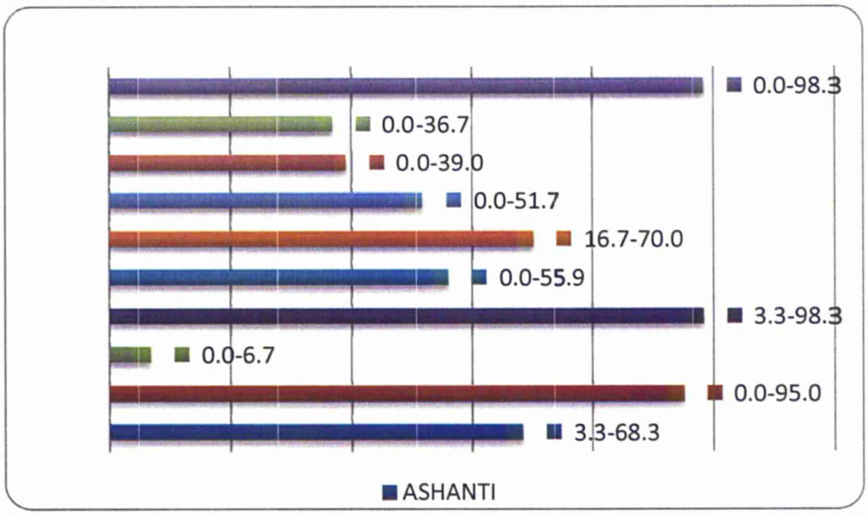


Figure 8.2: *S. mansoni* Prevalence Rates by Region

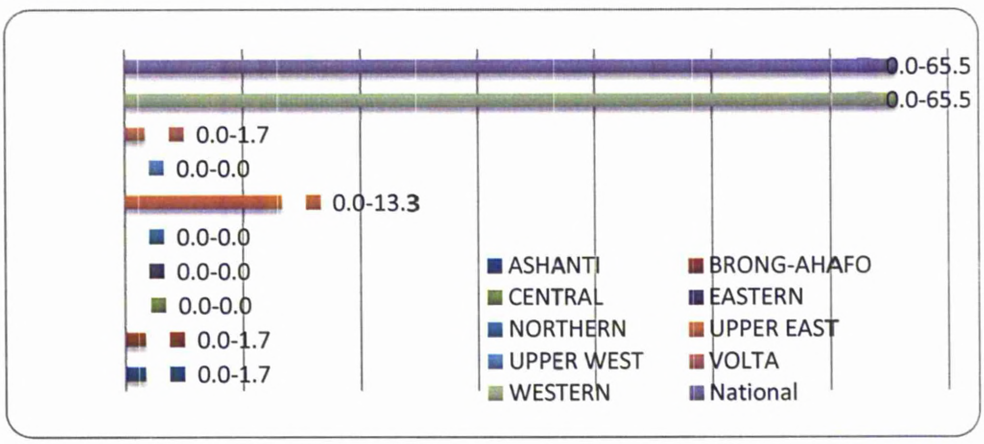
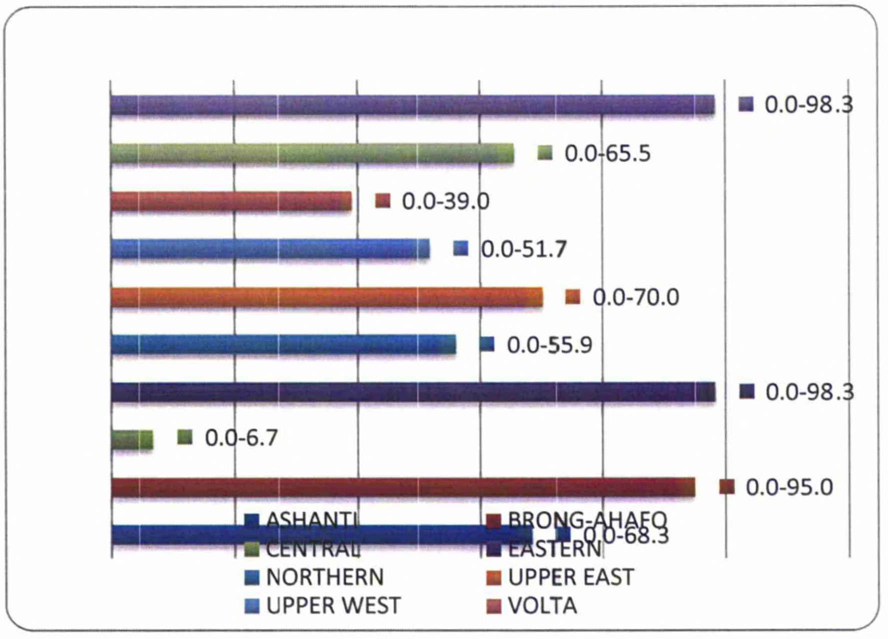


Figure 8.3: Combined Prevalence Rates for *S. haematobium* and *S. mansoni* by Region



The final risk map was stratified into areas where prevalence is more than 50%, areas where prevalence is between 30-50%, 20-30%, 10-20% and the areas where prevalence is less than 10%. Prevalence maps were created for *S. mansoni* and *S. haematobium* and a third map for both. The combined map is the most significant for directing treatment with praziquantel, however the individual maps can also be utilised from a research perspective.

Preliminary analysis was carried out in June 2008 after data entry was completed. Ghana having undergone re-demarcation of the country's administrative districts from an initial 110 districts to 138 had recently undergone further re-demarcation into 170 administrative districts. This presented a challenge for the analysis of the collected field data. Identifying the appropriate Ghana district map files for undertaking this task therefore presented a challenge as shape files for the 138 instead of 170 districts were applied. The data were entered in Epi Info 6 and cleaning of the data done and the information translated into a map for programme planning. Some of the problems noted with the data were improper recording of the school coordinates and non-matching of district names with those found on in the district shape files and this made it impossible to apply the coordinates to produce the preliminary map. However, the prevalence levels of *S. mansoni* or *S. haematobium* in the schools within districts were applied to the preliminary maps (Figures 8.1-8.3) and also in the selection of districts for the initial treatment in year 2008. The results were analysed according to the Schistosoma species identified and a composite map was produced since the control strategy is the same for both species of schistosome. Due to problems with the recording of the GPS co-ordinates, the districts from which the schools were sampled were used as the units of endemicity and implementation. Districts with prevalence levels of more than 50% and adjacent districts were designated as areas of high endemicity that required treatment of the school-aged population and associated communities, while those with prevalence levels of between 10 and 50% will require bi-annual treatment of school-aged children; those with a prevalence below 10% will only need to be treated twice during their primary schooling period.

The study showed 119 out of 138 districts in the country were endemic for schistosomiasis. A total at-risk school-aged population identified was about 4,902,854 and required 14,708,562 tablets per year of praziquantel for treatment of the school-aged population in the whole country.

With production of the final schistosomiasis endemic maps 141 districts out the present district total of 170 have been identified as having endemicity levels for schistosomiasis that required regular treatment, however, the treatment strategies was dependent on the prevalence in the different districts (Figures 8.7 – 8.10).

About 9 of the districts with a total population of about 322,525 had prevalence rates of more than 50% requiring annual treatment with praziquantel. About 118 districts with a population of about 5,768,310 had prevalence rates between 10% and 50% and required treatment with praziquantel every other year. Finally 14 districts with an estimated population of about 527,229 had prevalence rates less than 10%. For these 14 districts the strategy is to ensure that school-aged children were treated twice during their primary school period. First treatment is to be done when children entered primary school and second treatment on exit. This required that plans were made to ensure treatment for all these districts with an estimated total school-aged at-risk population of about 6,618,064. These estimates were for both *S. mansoni* and *S. haematobium* infections.

Figure 8.4: Predictive map of *S. mansoni* prevalence

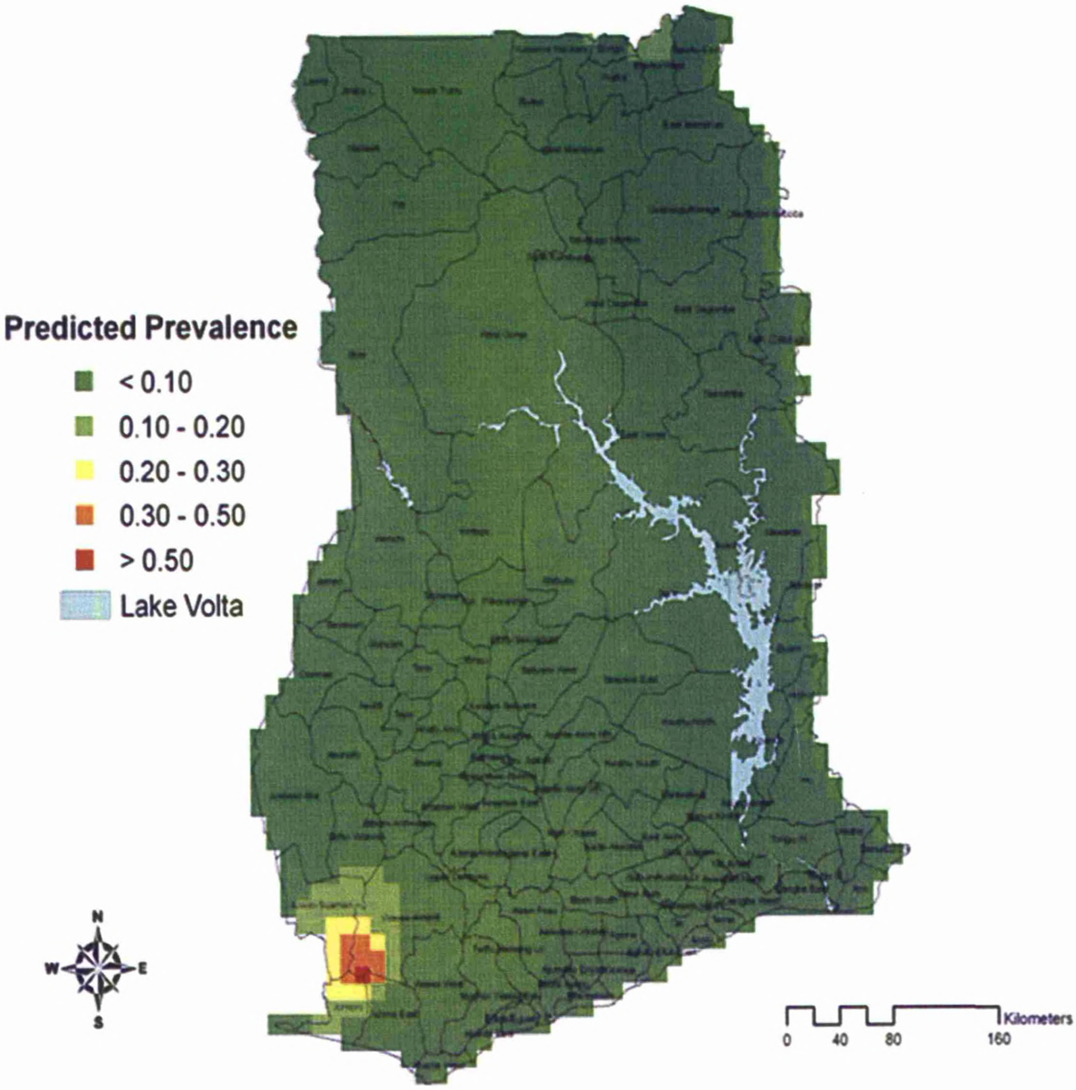


Figure 8.5: Predictive map of Soil Transmitted Helminths

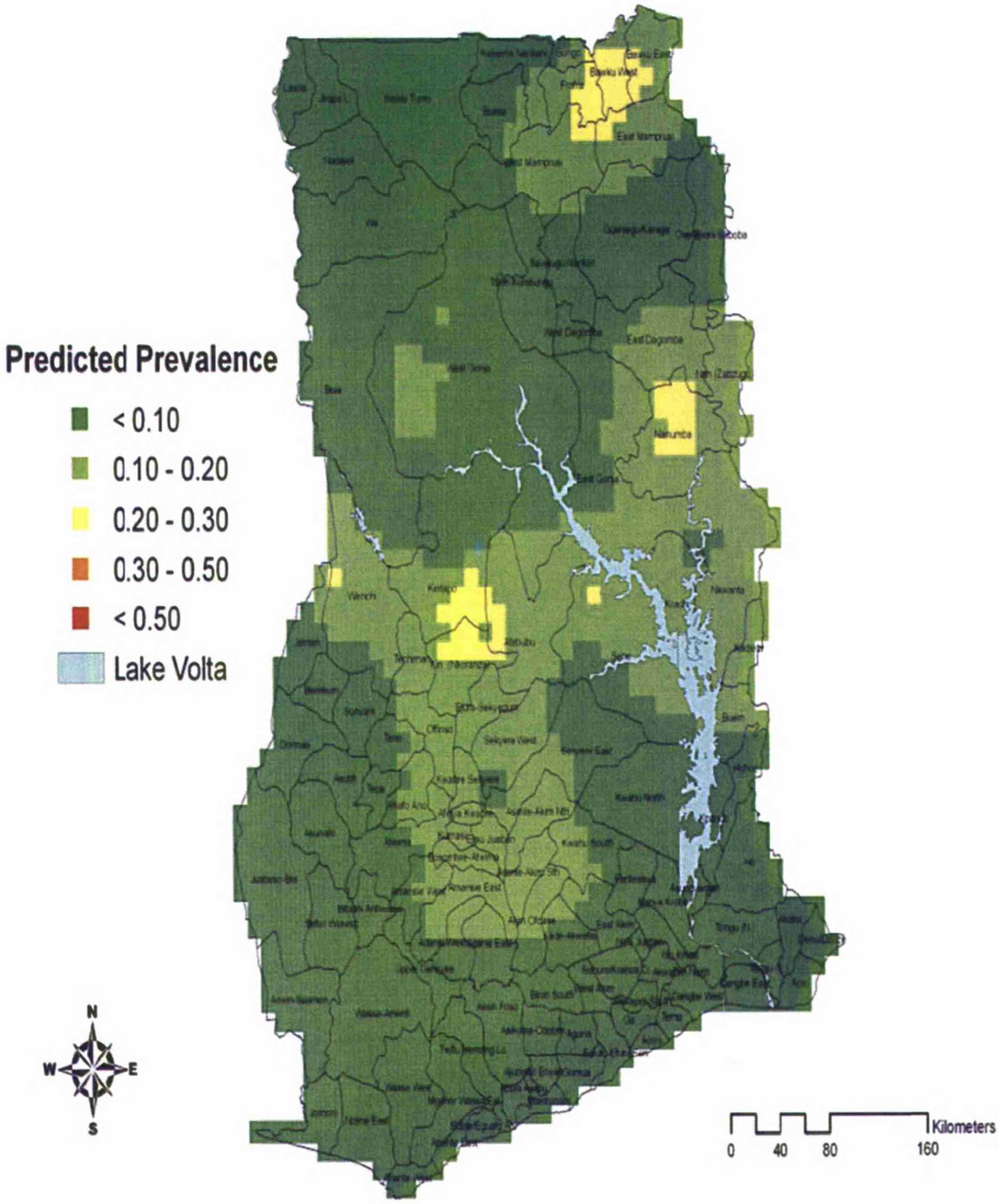


Figure 8.6 Predictive map of *S. haematobium* distribution

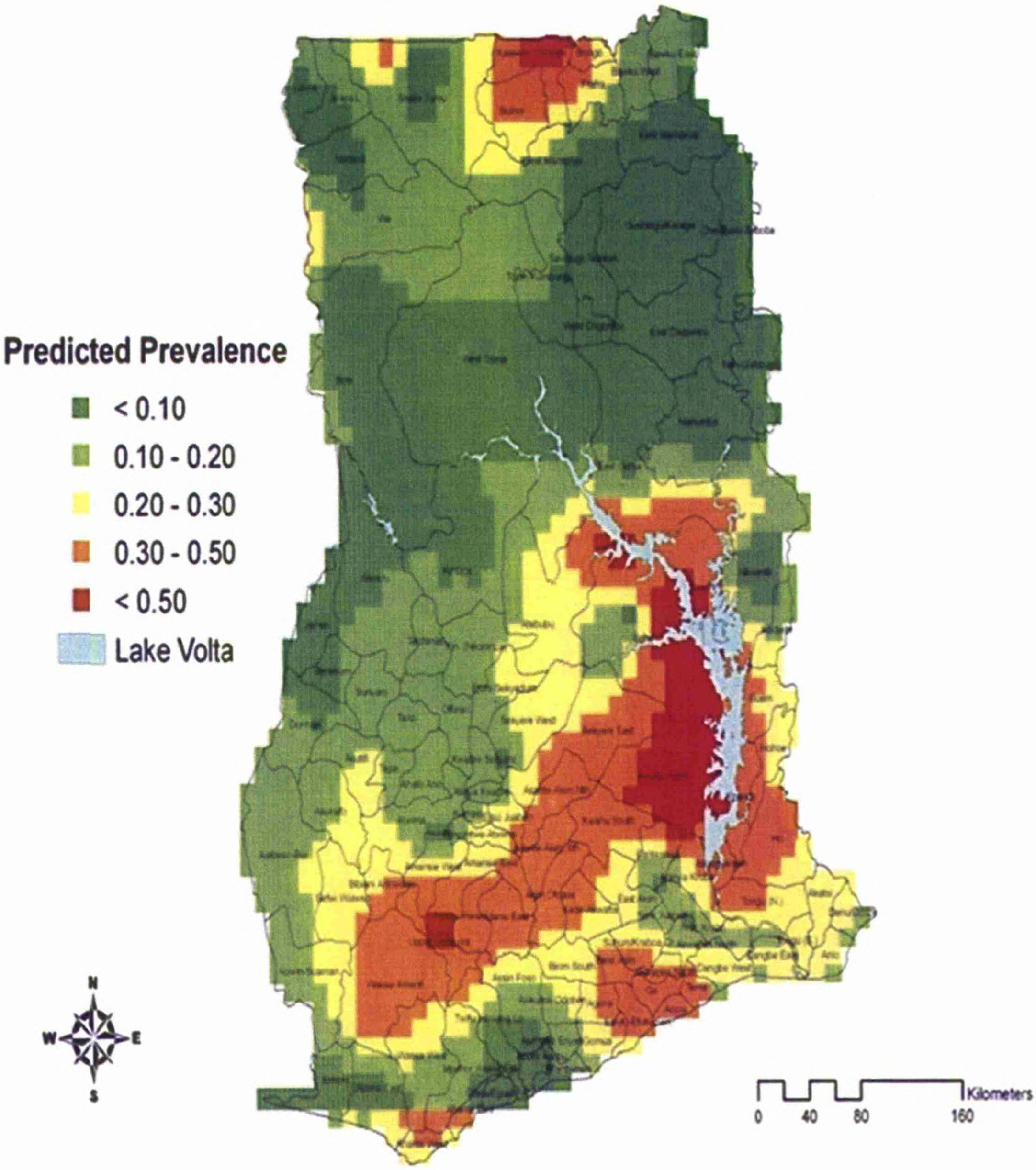


Figure 8.7a: Point prevalence map of *S. mansoni*

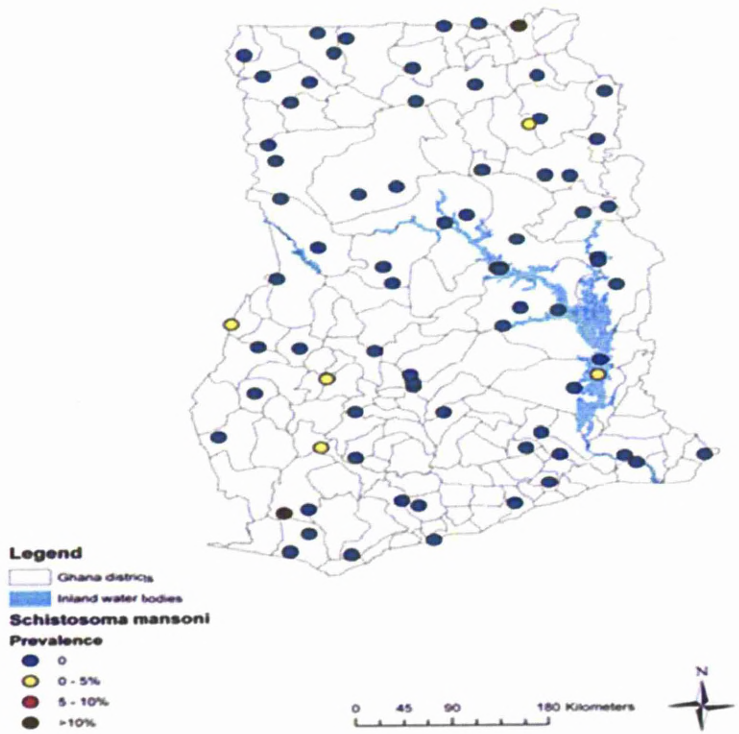
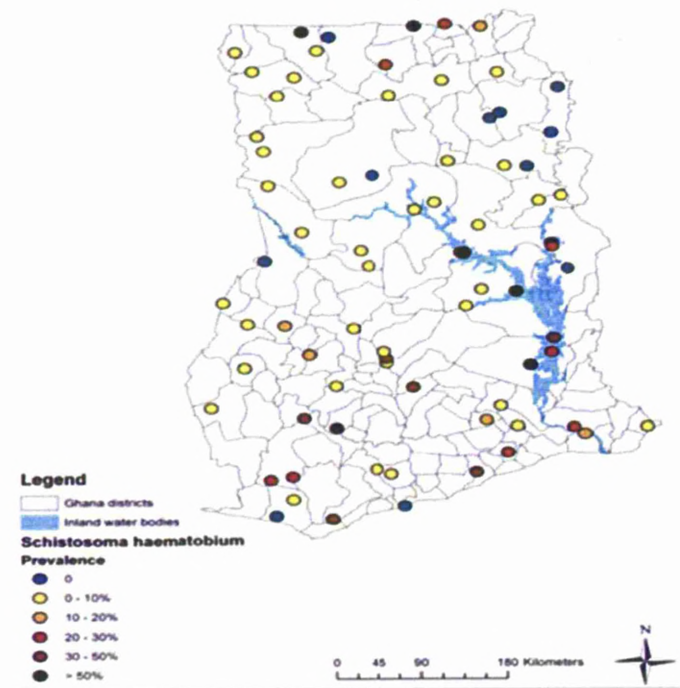


Figure 8.7b: Point prevalence map of *S.haematobium*



The major soil-transmitted helminths (STH) in Ghana are *Ascaris lumbricoides, Trichuris trichura, Necator americanus/Ancylostoma duodenale* and *Strongyloides stercoralis*. All previous 138 districts, now 170 districts in all the ten regions of Ghana are known to be endemic for all these soil-transmitted helminths from hospital records since no definitive comprehensive countrywide prevalence studies had been done. The opportunity to collect this data presented itself with the schistosomiasis mapping. Final predictive maps produced for soil transmitted helminths have indicated that endemicity of soil transmitted helminths is low in most of the districts in Ghana (Figure 8.5). About 11 districts have prevalence of between 0.2 – 0.3, another 36 have prevalence between 0.1 – 0.2 with the rest being 123 in number out of the present 170 districts having prevalence rates less than 0.1. All these identified categories of district would require different treatment strategies for control. Those districts with prevalence, between 0.2 and 0.3 would require treatment yearly, while those with prevalence less than 0.2 would not require mass treatment programmes. This low prevalence of soil transmitted helminthiasis could be due to several years of MDA with ivermectin and albendazole for LF control. In February 2007, there was a nationwide school de-worming exercise that provided mebendazole to all school-aged children in the country. This exercise though initially challenged with rumours of school children experiencing severe side reactions including unconfirmed deaths (Doodo et al, 2007), damage control efforts embarked on through the collaborative efforts of the Ghana Health Service and the Ghana Education Service ensured the exercise was largely successful with good geographic and therapeutic coverage (Doodo et al, 2007). In addition, households in Ghana are in the habit of regularly de-worming children at semi-annual or even quarterly time intervals. However, further operational research is required to explain why some areas which have had several years of treatment with ivermectin and albendazole continue to have significant levels of soil transmitted helminths infestation among children.

8.10 Conclusion

The results of this mapping exercise confirm that schistosomiasis infection still remains a significant public health problem in Ghana. Soil Transmitted Helminthiasis is, however, not at present a significant health risk among the school-aged population probably due to previous consistent mass treatment programmes for LF and onchocerciasis with anti-helminthics. These programmes have been ongoing for many years mostly targeted at school-aged children with some targeted at whole communities under the LF Elimination Programme and the recent school-aged de-worming exercise of the School Health Programme of the Ghana Education Service and the NTD Control Programme of the Ghana Health Service. Many other local NGDOs present at the district level have also undertaken district level mass de-worming exercises which are not formally reported to Health or Education authorities and only appear in the national media.

With the completion of schistosomiasis mapping and the production of endemicity maps 141 districts have been earmarked for mass treatment. A total of 6,618,064 school-aged children have been identified as being at risk of schistosomiasis. Based on this figure some 16,545,160 tablets of praziquantel will be needed for treatment countrywide in a year.

Such information is needed to forecast for procurement and implementation of mass treatment with praziquantel and also albendazole and/or mebendazole for the school-aged population. The data will also be valuable in monitoring the impact of treatment of schistosomiasis and soil transmitted helminthiasis programmes implemented using the WHO recommended treatment guidelines on mass preventive chemotherapy.

There is the need for further research to explore the reasons why there are certain areas of high soil transmitted helminths prevalence among school-aged children compared to other areas with similar socio-demographic characteristics with low prevalence, to inform programme decisions. In addition there is the need to validate the results of the exercise. These predictive maps have only enabled the programme to select whole districts for treatment. Schistosomiasis is focal in its transmission and therefore additional data collection might be required to help select smaller treatment units for praziquantel treatment, particularly using information on environmental, water contact and other factors influencing transmission.

Chapter 9

Impact on Other Neglected Tropical Diseases: Remapping and Relaunching of Onchocerciasis

Chapter 9: Impact on Other Negected Tropical Diseases:
Re-mapping for re-launching of onchocerciasis control in Ghana

9.1 Introduction

The levels of Onchocerciasis endemicity were evaluated in 705 villages by rapid epidemiological assessment (REA) combined with limited skin snip test in 105 villages. The purpose was to determine the prevalence and distribution of onchocerciasis leading to the selection of endemic communities for community directed mass distribution of ivermectin in these endemic communities in Ghana. Sampling methods followed the WHO/APOC Rapid Epidemiological Mapping of Onchocerciasis (REMO) protocol (De Sole et al, 1991, Macea et al, 1998, Noma et al, 1998) employing available topographical maps.

Onchocerciasis is another neglected tropical diseased, which relies on the preventive chemotherapy and transmission control (PCT) strategy for control. It is filarial disease caused by the nematode *O. volvulus,* which is transmitted by the black fly *Simulium damnosum*. The disease is endemic in 28 sub-Saharan countries in Africa including Ghana, in Yemen, and in small foci in six Latin American countries (WHO, 1995). It is highly debilitating, giving rise to severe visual loss and blindness and severe itching with dermal changes (Figure 9.1). The disease is often referred to as 'river blindness' because the populations that are worst affected live close to the fast-flowing rivers where the vectors breed. In these highly endemic communities, the disease has a serious socio–economic impact, as up to 40% of the adult workforce may be severely visually disabled, with additional debilitation caused by itching and dermal lesions (WHO, 1995). The pathological changes associated with *O. volvulus* infection include onchodermatits or onchocercal skin disease (OSD), lymphadenitis (resulting in hanging groin and elephantiasis of the genitals) and ocular lesions (blindness and impaired vision). Several other features of uncertain association, aetiology or pathogenesis have been described including low body weight, general debility and musculo-skeletal pain, epilepsy and dwarfism (Nwoke, 1992). The community prevalence rates, intensity or microfilarial worm loads determine the levels of the clinical manifestations.

The distribution, abundance and biting intensity of *Simulium* in endemic areas also contribute to disease transmission and the clinical manifestations. A large number of streams and rivers drain Ghana. These include a number of coastal lagoons, the huge man-made lake Volta among others which generate rapids which serve as breeding sites for the black fly vector. Several streams and rivers also become flooded during the rainy seasons creating the conditions for breeding of the black fly and onchocerciasis transmission (Macea et al, 1998, Noma et al, 2002).

The WHO-led former OCP relied on prolonged, regular larviciding of the vector breeding sites with rapidly biodegradable insecticides. An evaluation of the former OCP activities and its impacts on transmission revealed that transmission was virtually interrupted, and progression of eye lesions to blindness was halted as well as reduction to zero of new infections (Figures 9. 2 and 9.3).

Ghana has been involved in the control of onchocerciasis since the inception of the former Onchocerciasis Control Programme, which was based in Ouagadougou since 1974. Onchocerciasis control interventions implemented in Ghana have included aerial larviciding, and the use of mobile treatment teams for distribution of ivermectin, but since 1998 Ghana employed the Community-directed treatment with ivermectin (CDTI) as its main strategy for control (Taylor et al, 2009). However, poor financial support coupled with management challenges led to erratic distribution of ivermectin with poor therapeutic and geographic coverage for most of the treatment areas. Since 2004 when the LF elimination programme was combined with the onchocerciasis programme, the onchocerciasis programme has made significant improvements in its geographic and therapeutic coverage. Up to date mapping data was not available for the country and so the programme relied on historical data compiled from regional and districts health teams to guide treatment for onchocerciasis. With support from the African Programme for Onchocerciasis Control (APOC), this survey was led, coordinated and conducted by the PhD student.

The goal of the Ghana Onchocerciasis Control Programme is to reduce onchocerciasis prevalence to such low prevalence that it ceases to be of public health concern;

The specific objectives of onchocerciasis control in Ghana are;

- To maintain and sustain a drug therapeutic coverage of between 80-85% with a 100% geographic coverage.
- To reduce community microfilaria loads (CMFL) to less than 0.5/skin snip
- To reduce black fly infectivity rates to less than 0.5 per 1,000 flies in all endemic villages

Nine out of ten regions in Ghana are endemic for onchocerciasis and are all implementing the CDTI (community-directed treatment with ivermectin) strategy. The districts co-endemic for LF and onchocerciasis have consistently received ivermectin annually since the inception of the LF programme which distributes ivermectin and albendazole annually in meso and hyper-endemic areas. Since 2009 the programme has conducted twice a year treatment with ivermectin in all identified hyper- and meso-endemic communities. Meso-endemic areas are those with *Onchocerca* nodule rates between 20 – 39% while hyper-endemic areas range from 40% and above (Macea et al, 1998, Noma et al, 2002). The lack of empirical data to reinforce Ghana's selection and treatment of onchocerciasis endemic communities led to this remapping of onchocerciasis.

9.2 Rapid Epidemiological Mapping of Onchocerciasis (REMO) in Ghana

Rapid epidemiological mapping of onchocerciasis (REMO) in Ghana was undertaken to accurately and rapidly re-map and identify communities suffering from onchocerciasis with the development of maps as standard tools to guide the country to prepare a national plan for onchocerciasis control and to re-launch mass treatment of identified onchocerciasis communities with ivermectin for the control of onchocerciasis. The REMO maps serve as tools for monitoring and evaluation of onchocerciasis control activities.

The main objective was to undertake re-mapping of onchocerciasis in Ghana using the method of rapid epidemiological mapping of onchocerciasis eventually leading to the selection of communities from hyper- and meso-endemic areas for distribution of ivermectin.

REMO is a simple, non-invasive and practical method that is easy to apply over wide-range of bio-ecological zones with no socio-cultural or religious restrictions. It involved the division of the country into bioclimatic or bio-geographical zones, each of which is reasonably uniform with regards to the potential for onchocerciasis (Macea et al, 1998, Noma et al, 2002). The selection of communities was optimally biased towards communities of higher risk of onchocerciasis in each of the zones, in order to determine whether onchocerciasis is present or not and if present to give an indication of its distribution and severity. Finally a measure of the level of endemicity of onchocerciasis in the selected communities using the rapid epidemiological assessment (REA) method based on nodule prevalence after nodule search in the sample of adults was undertaken.

Two types of communities are selected, the high-risk communities and those situated in the areas most likely to have the worst disease profile, and communities in the immediate vicinity of major potential vector breeding sites as revealed on the available topographical maps. Selection of the 'high-risk' or 'first line' communities which are those that are located close to the rivers (preferably those communities close to rapids) and without other human settlements between them and the river rapids, with preference being given to the isolated communities was undertaken. At least one high-risk community was selected in each district per stretch of the river, and along every 30-50 km stretch on the main river, and in the valley of each major tributary (Macea et al, 1998, Noma et al, 2002). Ideally an alternative village with similar characteristics to the original choice and likely to suffer the same challenge of onchocerciasis transmission was chosen for each of the high-risk villages selected. An alternative village was then surveyed if the original choice could not be located or reached or had unco-operative population.

For each of the high-risk villages or its alternative, the mapping group chose a related secondary village which was located at least 10km further away from the probable main source for the vectors (Macea et al, 1998, Noma et al, 2002). The aim of the selecting secondary villages was to obtain some indication of the distribution and overall severity of the disease over a wider geographical area. Survey of a secondary village was only undertaken if at least some of the high-risk communities were proven to be meso- or hyper-endemic for onchocerciasis. Rapid epidemiological assessment methods in

REMO surveys should be undertaken in the dry months of the year when farming activities are less and villages are most accessible (WHO, 1993; WHO, 1995b). In each community, a random sample of 50 adult males or females aged more than 20 years were examined for the presence of onchocercal nodules. All the subjects investigated were engaged in rural occupations and resident in the community for at least two years. Males are preferred because they are more likely to be heavily infected as compared to females and they are more amenable to physical examination by palpation than females. Due to difficulties in obtaining adequate numbers of males for the surveys and willingness of women to be examined, women were also surveyed. This was done without prejudice to the standard requirement of examining of 50 adult males. In villages where there are fewer than 50 adult males available for examination, all the suitable consenting men and then consenting adults females were examined until 50 adults had been examined (Macea et al, 1998, Noma et al, 2002).

Validation of the results was undertaken within 2 months of the completion of the surveys using a team which included a group of independent experts, who surveyed a sample of villages where the original rapid assessments were conducted (WHO, 1995). The validation of villages involved selection of a stratified random sample method that took into account the different ecological zonal partners and levels of reported onchocercal endemicity.

9.3 Sampling and Results of REMO Surveys

The levels of endemicity were evaluated in 705 villages by rapid epidemiological assessment (REA), a method based on the examination of nodules (Ngoumou & Walsh, 1993). Initially a total of 753 villages were selected but only 705 were accessible at the time of the survey. The survey also combined nodule examination with skin snip assessments in 85 villages in order not to exclude potential onchocerciasis endemic villages because of the country's long prior exposure to Ivermectin treatment. A total of 705 villages (Table 9.1) were sampled.

Table 9.1: Sampled REMO Villages by region

Region	REMO Villages	Skin Snip Villages	Proportion
Northern	120	10	8%
Ashanti	83	11	13%
Eastern	118	6	5%
Western	124	14	11%
Central	26	14	54%
Upper West	46	7	15%
Upper East	22	6	27%
Volta	68	9	13%
Brong Ahafo	86	6	7%
Greater Accra	12	2	17%
Total	705	85	12%

Sampling of REMO villages was based on WHO/APOC REMO manual (Ngoumou & Walsh, 1993) with due regard to adequate coverage of major potential vector breeding sites as revealed by available topographical maps. It seeks to stratify the country into the following; ecological behaviour of the vector, epidemiology of the disease and geography of the areas. The sampled villages were comprehensively selected with appropriate topographical maps. Selection of REMO villages is optimally biased towards those at high risk of infection implying that villages closest to black fly breeding sites normally had high disease infectivity levels as opposed to villages that are further away from the breeding spots. A clinical examination for *Onchocerca* nodules from a random sample of 30 – 50 resident adults more than 20 years of age in selected villages gives a clear epidemiological pattern of the disease. The survey also included case search for Buruli Ulcer and cases of blindness as part of assessing the burden and distribution of other NTDs.

A total of 27,635 persons, living in 705 communities, were surveyed (Table 9.2). Even though participation in the survey was voluntary, field teams led by the research student spent time at each village to systematically examine the body following a standardized routine that gave attention to bony prominences particularly the iliac crest. Cervical and inguinal areas were excluded to avoid confusion with enlarged lymph nodes. Similarly in areas where skin snips were taken two skin snip biopsies were taken from the iliac crest, and after a drop of normal saline had been added it is examined under the microscope after thirty minutes of incubation. The GPS coordinates were obtained in each village using a hand-held Garmin Global Positioning System (GPS) unit from the centre of the surveyed village. Analysis of data was done using arc-GIS software. Demographic characteristics of villages and contacts of village heads were also collected.

Figure 9.1: Nodule search during REMO surveys

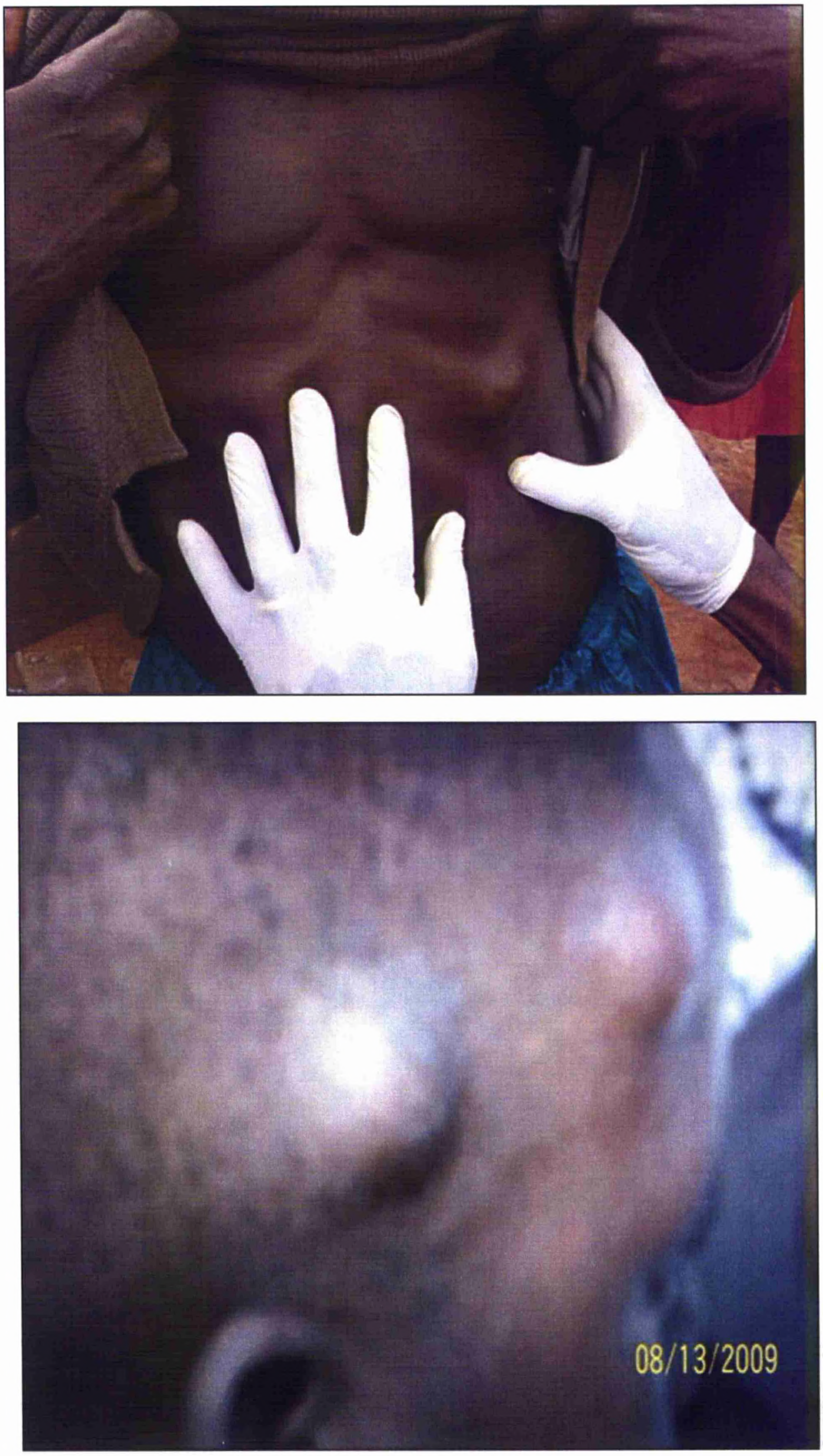


Table 9.2 Overall Summary Results for Nodule Examination and Skin Snipping for Microfiladermia

No. Examined for Nodules	27,635
Nodules Positive	1,091
Overall Nodule Positive Rate (%)	3.95
No. Skin Snipped	3,966
No. Positive for Skin Snip	365
Overall Crude Prevalence (%)	9.2

Table 9.3 Summary of Onchocerciasis Mapping Survey Results by Region

	Nodule Examination			**Skin Snippinng for Microfiladermia**		
Region	**Number of Individuals Examined**	**Number of Nodule Positive Individuals**	**Nodule Prevalence (%)**	**Number of Individuals Examined**	**Number of Microfiladermia Positive Individuals**	**Microodermia Prevalence Rate**
Ashanti	3005	140	4.7	679	111	16.3
Brong Ahafo	3268	115	3.5	244	2	0.8
Central	1020	82	8.0	501	95	19.0
Eastern	4772	163	3.4	464	51	11.0
Greater Accra	341	1	0.3	106	0	0.0
Northern	4741	249	5.3	394	53	13.5
Upper East	718	16	2.2	233	0	0.0
Upper West	1869	47	2.5	307	14	4.6
Volta	2882	134	4.6	450	18	4.0
Western	4987	144	2.9	588	21	3.6
TOTAL	27603	1091	4.0	3966	365	9.2

Table 9.4: Results of Blindness and Buruli Ulcer Case Search

Region	BLINDNESS CASES		BURULI ULCER CASES	
	NO.	Proportion of Total Number Identified (%)	NO.	Proportion of Total Number Identified (%)
Ashanti	55	4.5	8	8.9
Brong Ahafo	87	7.1	7	7.8
Central	47	3.8	2	2.2
Eastern	89	7.2	14	15.6
Greater Accra	3	0.2	2	2.2
Northern	356	29.0	14	15.6
Upper East	364	29.6	0	0.0
Upper West	64	5.2	1	1.1
Volta	106	8.6	11	12.2
Western	58	4.7	31	34.4
TOTAL	1229	100	90	100

9.4 Discussions

Out of a total of 705 villages surveyed for REMO 85 of them forming 12% (Table 9.1) of communities surveyed also had the skin snip test conducted in them. Of the 27,603 individuals examined, 1091 (4%) were positive for skin nodules. This proportion varied from 0.3% in Greater Accra Region to 8.0% in Central Region (Table 9.4 and Figure 9.6). A total of 3966 individuals from 85 villages were skin snipped. About 365 (9.2%) of them were positive for onchocercal microfilariae and which varied from 0.0% in Greater Accra Region to 16.3% in Ashanti Region. Case search for blindness and Buruli ulcer disease discovered a total of 1229 cases of blind individuals and 90 cases with Buruli ulcer. Northern and Upper East Regions had the highest number of blind cases, 29.0% and 29.6% respectively contributing a total of 58.2% of all the cases. Greater Accra had the least of 0.2%. The greatest proportion of Buruli ulcer cases was found in the Western region (34.4%)

while Upper West had the least (1.1%). Northern and Eastern regions had the second highest of Buruli ulcer cases of 15.6% each. Community nodule prevalence rates varied from 0.0% in many regions to 59.4% in one community in Ashanti region while community microfilarial prevalence also varied from 0.0% in many communities across the country to 53.1% also in one community in Ashanti region (Table 9.4).

The total number of blind cases identified in the Northern and Upper East regions (58.6%) gives a possible indication of the severity of onchocerciasis and other blinding diseases in the northern parts of country. This might be evidence in support of early prevalence studies, which led the former OCP to focus the onchocerciasis in the northern parts of the country which was well known for blinding onchocerciasis. While onchocerciasis could be the contributory factor to old cases of blindness, trachoma might be the main contributory factor to new cases of preventable blindness in the northern parts of Ghana. The contribution of other non-infectious causes of blindness such as cataract, hypertensive eye disease and glaucoma among others should, however, be considered in this discussion.

The ecology of the Greater Accra region is not known to support the breeding of the black flies. None of the 64 skin snipped persons in the region was positive. Additionally, of the 12 selected villages examined for nodulesonly three (3) persons, one each from the three villages were positive with a nodule rate between 0 – 9%.

The results of these REMO surveys and previous epidemiological and entomological surveys were put together and applied to help delineate areas of onchocerciasis endemicity in Ghana. The main infected river basins were found to be the Pra, Pru, Offin, Afram, Bia, Bui-Black Volta, Daka and Majimaji river basins. Blackflies are known to be have a normal flight range of

20 kms within their breeding sites, though with the aid of other climatic and physical conditions they are able to fly a distance of 400 kms. Selection of communities for treatment was therefore done along the infected rivers but within the normal flight range of the black fly. Within these identified infected river basins the programme went on to identify all communities within 20km radius and list them as communities endemic for onchocerciasis and for which biannual treatment with ivermectin was instituted.

This re-mapping of onchocerciasis has also resulted in the discovery of ivermectin naive treatment areas which have never been known to be onchocerciasis endemic in Ghana. These are the Afram Plains district of the Eastern region, Ho municipal in the Volta region, and Amansie Central district in the Ashanti region.

Figure 9.2: Maps Showing Results of Rapid Epidemiological Mapping of Onchocerciasis (REMO) and Skin Snips for Onchocerciasis Microfilaridermia

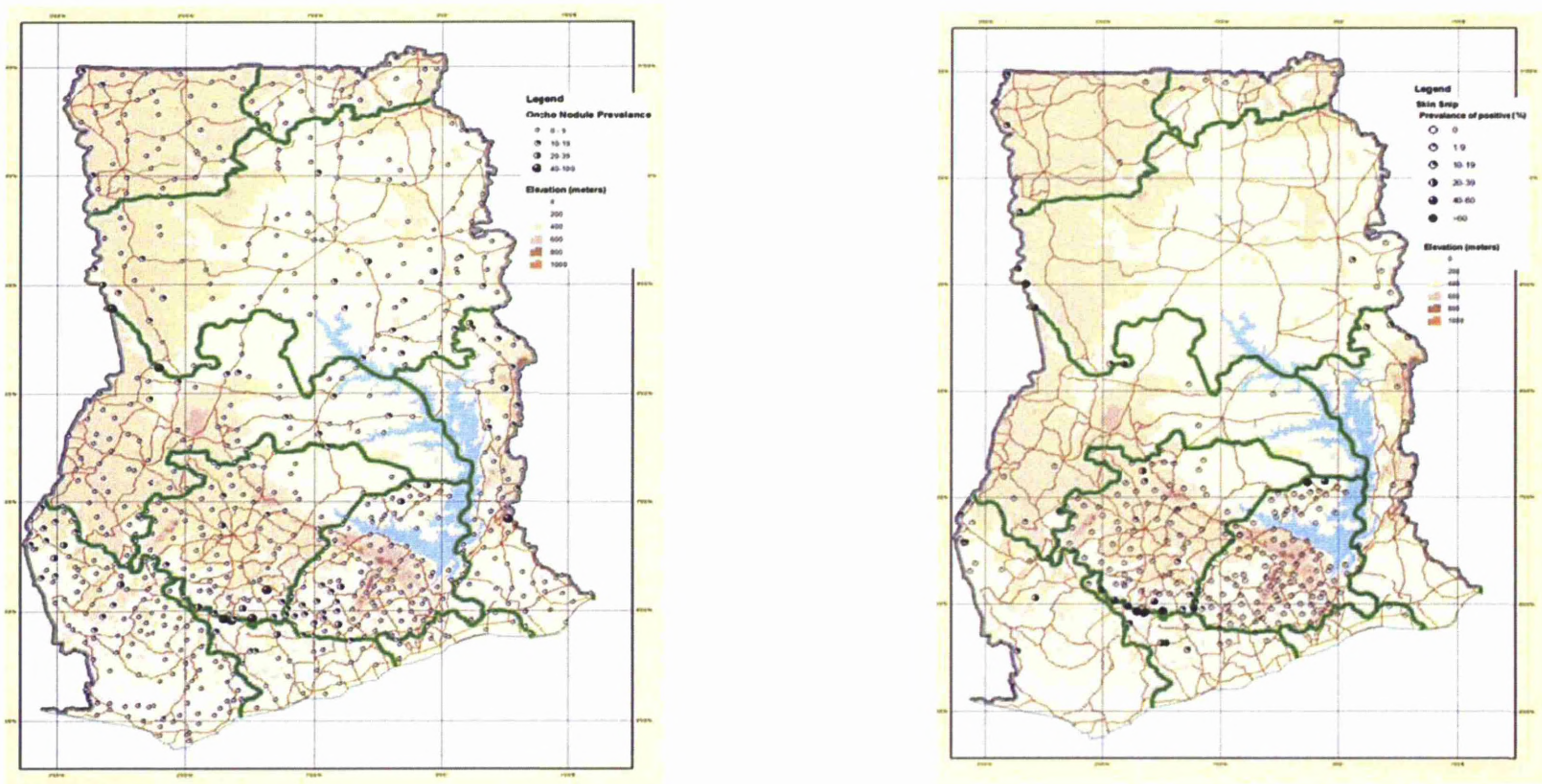
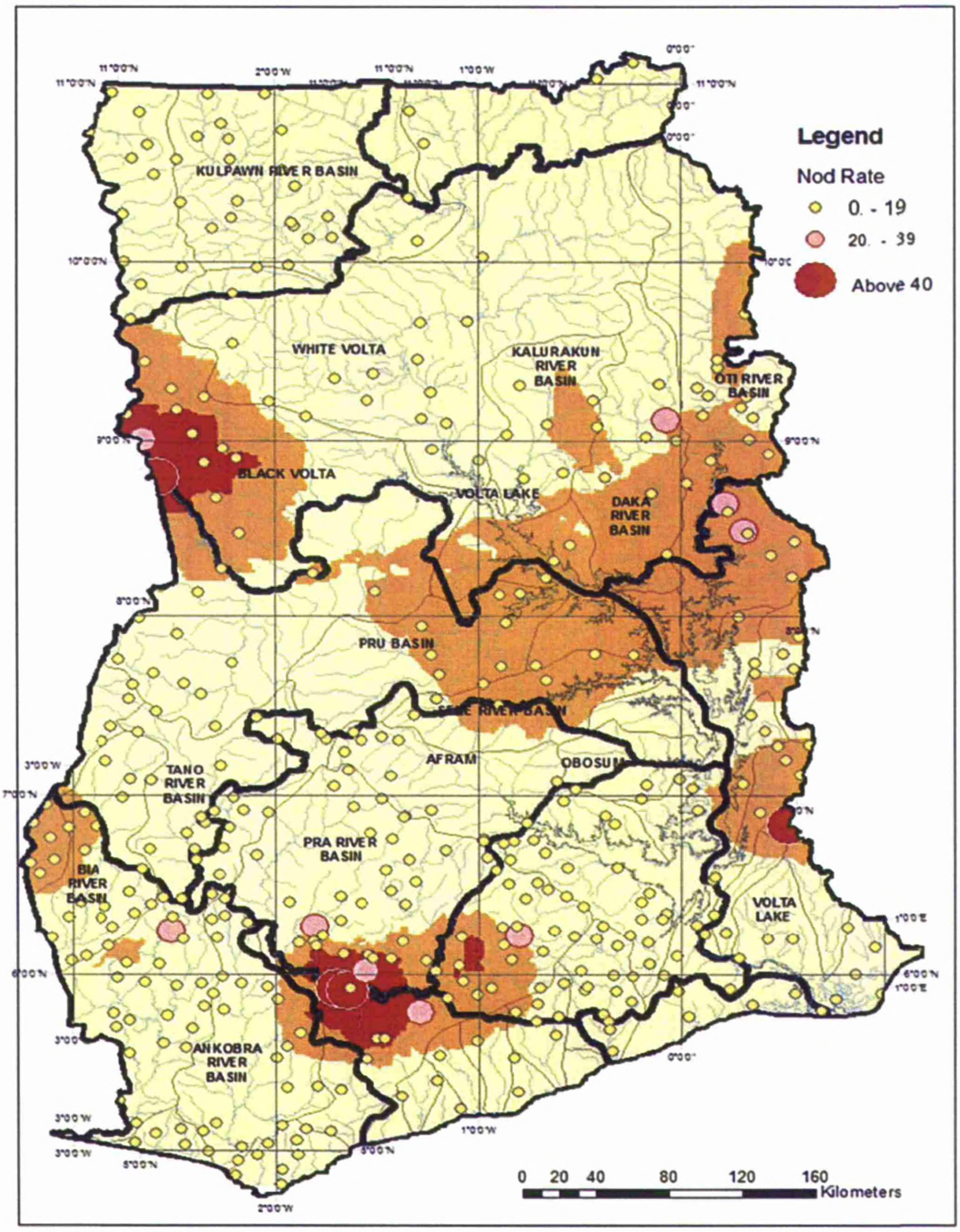


Figure 9.3: Map Resulting from Mapping of Onchocerciasis in Ghana showing Identified Endemic Areas for Onchocerciasis Treatment (REMO Map 2)



Several challenges encountered during the re-mapping of onchocerciasis in Ghana included poor timing of the surveys which coincided with the rainy season which rendered many roads particularly to the rural areas where these surveys were undertaken not motorable. Some communities selected on the available topographical maps were non-existent on the ground and had to be replaced. Other communities were simply inaccessible to the field teams. Many of the GPS coordinates initially collected were displaced either from the districts in which they were supposed to be located or displaced into the sea or other neighbouring countries with Ghana requiring that retraining and retaking of all GPS coordinates had to be undertaken.

9.5 Conclusions

Re-mapping and re-launching of the onchocerciasis control activities in Ghana was successfully undertaken with confirmation of onchocerciasis endemicity with the development of onchocerciasis endemicity maps to guide the community-directed treatment with ivermectin for onchocerciasis endemic communities. Several new foci have also been discovered requiring ivermectin treatment. Onchocerciasis in Ghana is therefore endemic in 9 out of the 10 regions in Ghana (Figures 9.6 and 9.7), in 40 out of the 170 districts, involving 3200 hyper- and meso-endemic communities, which have been selected for ivermectin treatment.

The development of a new strategic plan for onchocerciasis control within the context of the NTD Strategic Plan has been developed to address control of onchocerciasis in Ghana. In order to improve on coverage, overcome possible ivermectin non-response as reported in certain parts of the country (Awadzi et al, 2004, Osei-Atweneboana et al, 2007) and progress towards possible elimination of onchocerciasis in Ghana, twice a year treatment with ivermectin is to be implemented while monitoring for recrudescence for selected sentinel sites will continue. Annual treatment of all historically endemic onchocerciasis treatment areas will also continue.

There are many inherent challenges associated with the re-launching of onchocerciasis control activities in the country. These include shortage and aging technical officers to undertake surveillance activities on the programme, recrudescence of onchocerciasis in certain endemic areas, competition with other health programmes and inadequate financial resources all of which hamper the successful re-launching of onchocerciasis control activities.

However, re-launching activities built into the plan include building the capacity of national, regional and district health officers to coordinate and undertake onchocerciasis control activities including surveillance and treatment with ivermectin. Production of community registers to replace old ones and for newly discovered treatment communities' new registers to be produced will be undertaken. A 5-year onchocerciasis surveillance plan is also to be developed and incorporated into the general work plan for onchocerciasis control.

Chapter 10

Discussion, Challenges, Recommendations and Conclusions

Chapter 10: Discussion, Challenges, Recommendations and Conclusions

10.1 Introduction

The goal of the GFEP has been the elimination of LF by the year 2010. This fell within the time frame of the GAELF, which targeted the year 2020 for elimination. The main strategies employed in order to achieve these goals involve the application of mass preventive chemotherapy using ivermectin and albendazole targeted at all endemic districts in countries like Ghana, which are co-endemic for LF and onchocerciasis.

Initial research to establish the endemicity of the LF in Ghana, mapping to delineate the extent of the problem, establishment of a programme to implement the identified strategies of MDA, morbidity control and health education, all of which should be well integrated into the health system have been pursued. During the period of implementation the LF programme has evolved from being a single disease entity programme to being merged with the onchocerciasis control programme into the integrated NTD Programme involving other neglected tropical diseases, which employ mass chemotherapy for their control. Several indicators have therefore been applied in measuring the impact of the GFEP. These include its impact on LF disease or programme specific indicators, impact on other NTDsand then its impact on the health system. This Chapter provides the opportunity to undertake this discussion in this context.

The main goal of this thesis is to determine the impact of MDA on the prevalence and transmission intensity of LF and investigate the suitability of the community directed approach as a vehicle for developing an integrated treatment strategy targeting other NTDs amenable to MDA within the context of the health system.

The LF elimination programme in Ghana has since its inception completed more than 10 annual rounds of MDA. Though the programme has missed its elimination target of 2010, it has made very significant impacts on many programme associated indicators. However, resource availability and its implications have to a large extent determined the impacts achieved under the programme.

LF specific indicators assessed include community antigen, microfilaria prevalence and intensity. Effect on morbidity determined by the change in quality and quantity of morbidity associated with elephantiasis/lymphoedema and hydrocoele cases. Most significant in this process is the capacity to determine the end point of MDA, which signifies the elimination of transmission of *W.bancrofti.* Achieving these impacts involve the process of ensuring the achievement of sustained adequate treatment coverage, which makes reported and surveyed treatment coverage important as process indicators.

These studies focused on the process from inception of the LF Elimination Programme, monitoring its implementation through surveys and determination of the impact of the programme both on parasitological and antigenic indicators of the infection and also its impact on the NTD control Programme. An attempt to determine the possible end points of the programme was undertaken. Some process, outcome and output indicators for the programme have been analyzed for discussion in this thesis.

The impacts of the LF elimination programme have been monitored through longitudinal and cross sectional surveys. The methods that have been employed applied parasitological and antigen test indicators and some indicators for programmatic assessment the LF Programme, the integrated NTD Programme and the health system at large. The determination of the possible end points of LF Elimination Programme has been undertaken in 5 selected districts. Some process, output and outcome indicators have been employed by collecting both longitudinal and cross-sectional quantitative and qualitative data programme data have been employed to demonstrate the impacts of the LF Programme on these selected indicators and on the health system.

Ghana's population of about 25 million is endemic for all the preventive chemotherapy diseases namely LF, onchocerciasis, soil transmitted helminthiasis, schistosomiasis and trachoma. The country has been mapped for all these diseases and the 10 regions have different mixes of these diseases with each region being endemic for a minimum of 3 of these preventive chemotherapy diseases. The LF Elimination Programme has made significant impacts on the epidemiology, implementation of LF in Ghana, the implementation of other NTDs the health system of Ghana. The prevention, control, elimination and even the eradication of the NTDs is on track via the platform of LF elimination.

After mapping LF was found to be endemic in the present 74 out of the 170 districts in Ghana. The LF elimination programme was merged with onchocerciasis control programme in 2004 and have since undertaken activities leading improvements in the immune-parasitological indicators of LF.

Table 10.1: Proportion of At-risk Population Covered by Mass Drug Administration by Preventive Chemotherapy Disease

PCT Diseases	Total Endemic Implementation Units (Districts)	Total At-risk Population (N)	Proportion of At-risk Population undertaking MDA (%)
Lymphatic Filariasis	74	12,265,335 (Total Population)	100%
Schistosomiasis	141	6,859,637 (School-Aged Children)	100%
Soil Transmitted Helminthiasis	170	6,859,637 (School-Aged Children)	100%
Onchocerciasis	40	2,075,542 (Total Population)	100%
Trachoma	29	3,096,238 (Total Population)	100%

Ghana is endemic for all the preventive chemotherapy diseases among the neglected tropical diseases. Onchocerciasis control activities started in Ghana under the former Onchocerciasis Control Programme of the World Health Organization in 1974. The programme at the time focused on black fly control using aerial larviciding. Ivermectin distribution started in 1987 with the use of mobile teams. The community-directed treatment with ivermectin strategy was introduced in 1998. Onchocerciasis control activities have since been undertaken under other onchocerciasis control initiatives such as Special Interventions Zones (SIZ) Programme and now the African Programme for Onchocerciasis Control (APOC).

The onchocerciasis control programme in Ghana was merged with the LF Elimination activities in 2004. The LF Programme has since provided the platform for implementation of onchocerciasis and other NTDs control activities which include MDA with ivermectin in all onchocerciasis endemic communities most of which overlap geographically with the LF endemic communities in Ghana. A single dose of ivermectin and albendazole administered to these co-endemic communities have had the benefit of having impacts on both LF and onchocerciasis transmission.

Subsequently the GFEP became the platform for implementing the integrated NTD Programme, which included implementing control activities for schistosomiasis, and the soil transmitted helminthiasis. Trachoma elimination activities were also planned for and implemented together with these other neglected tropical diseases, though it operated from within the Eye Care Department of the Institutional Care Division.

Activities aimed at the prevention, control, or elimination of these preventive chemotherapy diseases namely LF, onchocerciasis, schistosomiasis, soil transmitted helminthiasis and trachoma were co-implemented together and well integrated into the health system. This strengthened the health system through the provision of funds for capacity building of health workers and community drug distributors, drugs and other logistics, monitoring and supervision of community drug distribution and other community based health activities. The registers provided to the communities formed an excellent source of data for other community based health activities. It helped to identify the vulnerable populations within communities who include pregnant women and the children less than five years for Insecticide Treated Nets (ITN) distribution and other immunization programmes.

The World Health Assembly resolution (WHA 50.29) for the elimination of LF as a public health problem from endemic areas set in motion a series of global, regional and country activities aimed at ensuring the achievement of this final goal has been the guiding principle of Ghana's Programme to eliminate LF. The benefits of this programme have been its impacts on LF elimination and the programme, other NTDs and the health system as a whole.

Assessments of the programme implementation activities such as MDA with ivermectin and albendazole, morbidity control and monitoring and evaluation have provided the information relevant to making this determination. The achievements and challenges of the process have provided useful lessons to inform the recommendations and conclusions of this thesis.

The main goal of this study is to determine the impact of MDA on the prevalence and transmission intensity of LF and investigate the suitability of the community directed approach as a vehicle for developing an integrated treatment strategy targeting other NTDs amenable to MDA. The LF elimination programme was implemented as a single and specific disease control programme since the year 2000, merged with onchocerciasis control activities in 2004 and with schistosomiasis and soil transmitted helminths diseases control in 2006 while working very closely with trachoma elimination. This programme is now run as the NTD Programme with significant impacts on each other and the health system by being fully integrated into the National Health Care Plan.

This thesis setting out to test the hypothesis that with the current strategy of MDA and a minimum coverage of 65%, the programme has been able to achieve the interruption of LF within the period proposed by the WHO with significant impacts on *W. bancrofti* transmission and other NTDs employing preventive chemotherapy and transmission control activities.

The focus of this discussion is on the process from inception of the GFEP, monitoring its implementation through surveys and determination of the impact of the programme both on parasitological and antigenic indicators of the microfilaria worm and also its impact on the NTD Control Programme. Determining the possible end points of the programme has been undertaken.

The process, outcome and output indicators for the programme have been analyzed and discussed in this thesis.

10.2 Impact of the Programme on Lymphatic Filariasis Elimination

LF is endemic in 8 of the 10 regions and in 74 of the 170 districts in Ghana with an estimated at risk population of about 12 million in 2011 (2010 Demographic and Housing Census) which is about half of Ghana's population. The programmes started implementation activities in 2000 and by 2006 implementation activities including MDA were taking place all endemic districts. One of the objectives of the programme is alleviation of the suffering of individuals affected with disability. The programme therefore targets people with hydrocoeles and lymphoedema with free surgeries and hygiene management respectively.

The LF elimination programme has completed 10 annual rounds of MDA undertaken through a gradual up-scaling programme. Total geographic coverage was achieved by the 6th annual round of MDA in 2006. Achievements of coverage have ranged between 63.9% and 77.3% (Figure 10.1 and Table 10.2) nationally and total treatments achieved under the programme are about 40,687,937 with ivermectin and albendazole. The total quantities of albendazole and ivermectin used are about 185,220,291 and 53,993,541 tablets respectively.

Figure 10.3: Trends in National Geographic and Total Population Coverage for Lymphatic Filariasis Treatment

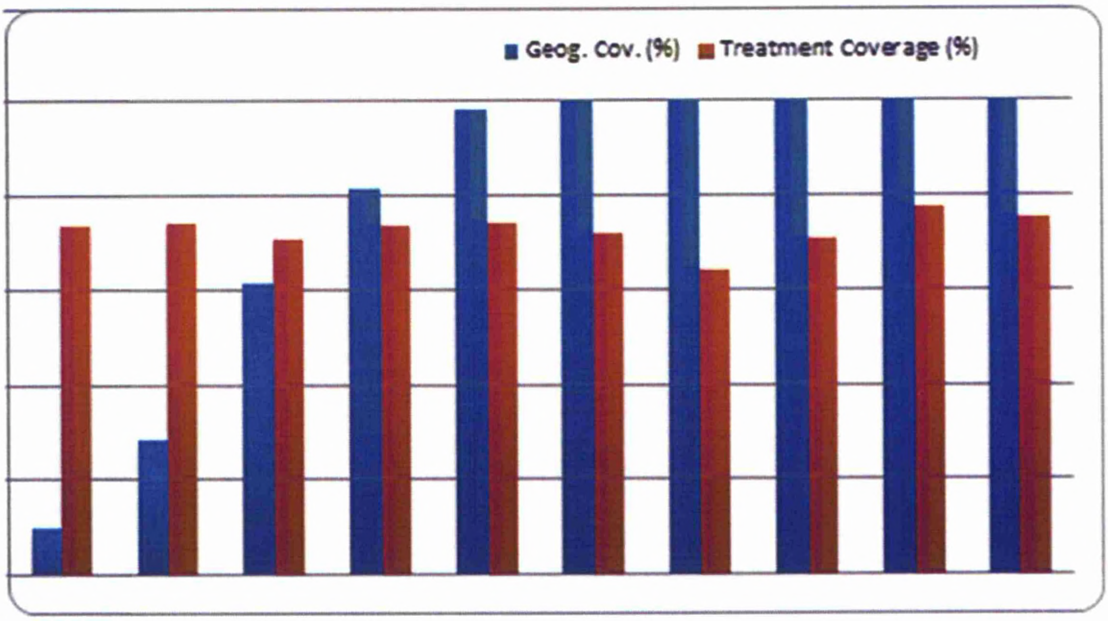


Table 10.2: School-Aged Children Dewormed through the LF Programme

Year	District	At-Risk Pop	Ivermectin	Albendazole	No. of Treatments	De-wormed Sch-Aged Children	Cov(%)
2001	5	333,686	1,001,000	333,596	246,743	67,361	73.9
2002	14	1,643,211	5,743,056	1,914,400	1,217,936	332,497	74.1
2003	30	3,696,893	9,100,000	3,522,000	2,622,722	716,003	70.9
2004	40	5,378,143	13,967,000	5,180,000	3,971,869	1,084,320	73.9
2005	60	6,907,375	25,000,000	8,598,900	5,141,482	1,403,625	74.4
2006	61	8,851,923	25,234,485	8,060,000	6,359,200	1,736,062	71.8
2007	61	9,278,935	24,080,000		5,932,174	1,619,484	63.9
2008	74	10,334,602	26,856,250	9,407,600	7,313,521	1,996,591	70.8
2009	74	10,331,867	25,575,000	8,035,100	7,913,735	2,160,450	77.3
2010	74	9963010	28,663,500	8,503,400	7491873	2,045,281	75.2
Total	-		185,220,291	53,993,541	40,687,937	13,161,673	-

Impact assessments undertaken involving the 5 start up districts and other districts that joined the programme at various stages in the up-scaling process have demonstrated significant impacts on both microfilarial prevalence and densities. There have been reductions in the microfilaria prevalence in the first 5 start up districts at mid-term and end of term evaluation carried out, though none of the districts achieved a prevalence of less than 1% as required to enable the programme proceed to determine the end point of MDA since the sixth annual round of MDA. Further longitudinal assessments undertaken after two more rounds of MDA identified two districts, Awutu-Afutu-Senya and Agona districts which had since been separated into 4 districts to have microfilaria prevalence of less than 1% and could proceed to the end point determination applying the new WHO designed transmission assessment survey protocol. Longitudinal impact surveys undertaken among the second and third batch of districts indicated a greater reduction in the microfilarial prevalence rates as compared to the 5 start-up districts with many of these districts having achieved microfilaria prevalence levels less than 1%.

Selection of districts for these end point determination surveys was informed by the programmes exit plan (Table 10.3) and results of longitudinal microfilarial impact surveys. Determination of the end point of MDA in the 5 start up districts was undertaken by applying the antigen Og3C4 and antibody Bm14 filter paper test methods. Using the TAS protocol the end point determination was also undertaken in 4 districts including Awutu-Efutu-Senya district which is one of the 5 start-up districts.

Table 10.3: Exit Plan of the LF Programme Elimination

Year	2010	2011	2012	2013	2014	2015	Total
Number of Implementation Unit (Districts) Involved	10	26	17	9	8	4	74
No. Evaluation Units Involved	4	7	6	4	4	1	26
Estimated Population Stopping MDAs	887,267	2,678,563	2,371,448	1,428,831	2,036,597	3,164,736	12,567,441
Estimated Population remaining	11,680,174	9,001,611	6,630,163	5,201,332	3,164,736	-	-

Generally trends in immune-parasitologic indicators showed significant downward trends in all programme districts surveyed. The first 5 start up districts also demonstrated good progress in the reduction of microfilaria prevalence. In comparison lower prevalence and more reduction in microfilaria prevalence were recorded among the second and third batch of districts to begin undertaking MDA.

Application of the Og4C3 antigen tests in the 5 start up districts among children 5 years or less indicated ongoing transmission after round 6 of MDA in all these 5 districts requiring further annual rounds of MDA. The results of the TAS in Awutu-Efutu-Senya and Agona districts demonstrated a break in transmission of LF and therefore have proceeded to undertake a two-year post-MDA surveillance.

Higher baseline microfilaria prevalence in the 5 start up districts is likely to be responsible for the difficulty in suppressing transmission in these districts compared to the second third batch of districts that the joined the programme. Two more annual rounds of MDA made it possible to suppress transmission further in Awutu-Efutu-Senya district, one of the 5 start-up districts which did not qualify with earlier surveys done. Transmission assessment surveys conducted ultimately indicated a possible interruption of transmission in Awutu-Efutu-Senya and Agona districts.

The results of these surveys indicate that the 5-6 years recommended for elimination of transmission with MDA may not be adequate but also requires attainment of the adequate coverage and should also take into consideration coverage achieved, compliance with MDA (Ottesen et al, 2008; Talbot et al, 2008; Cantey et al, 2010; Hodges et al, 2010), geographic coverage, characteristics of the vector and the drug regimen applied (Bockarie et al, 2009).

Providing morbidity control on programme has involved registration of hydrocele and lymphoedema cases, which was considered and undertaken at the inception of programme activities. The programme has been able to register and provide morbidity management through hygiene education to lymphoedema and free surgeries to hydrocoele cases.

Several workshops to build the capacity of medical officers to undertake hydrocoelectomies using the WHO recommended method of total excision of the hydrocoele sac have been undertaken. Free hydrocoele surgeries have been provided during these surgical workshops and camps organised by the programme. About 3000 free hydrocoele surgeries have been provided by the programme although about 10,000 cases of hydrocoeles registered. About 5,000 cases of lymphoedema have been registered and provided with education to enable them undertake hygiene management of the affected limb.

The free hydrocoele surgeries organized by the National LF Programme have made a major and positive impact on the physical, social and economic life of the people who have benefited from the service. Improved quality of life of the beneficiaries of the hydrocoele surgeries has been noted with the assessment of the morbidity management programme. Individuals indicated in the survey that mobility, self care, ability to undertake activities had improved while pain, discomfort, anxiety and depression associated with hydrocoele had reduced.

Apart from recording improvements in the socio-economic life, post-surgical recurrence had also been reduced to the barest minimum with the total excision method. The incidence of post surgical infection negatively impacted on the successful conduct and outcome of some surgeries since many patients with incompletely healed wounds mismanaged these wounds at home. The role of government facilities in the management of post-surgical complications was however significant.

The role of morbidity control in achieving the elimination targets of LF should not be underestimated since it builds the confidence of communities in the programme by playing an advocacy role in these endemic communities as well.

Observed trends in coverage in these 5 start-up districts indicated that coverage as reported has generally been adequate, though deviations between reported and surveyed coverage above 10% was observed in some districts for some years. However among the 5 start-up districts, reliability of the reported coverage had generally improved by year 4. Generally, coverage surveys are important in determining the reliability of reported coverage. Integrated coverage surveys are also possible and provided similar reliable results as those of the disease specific surveys.

10.3 Impact on Other Preventive Chemotherapy NTDS

The impacts made by the LF Programme on the LF transmission, other NTDs that employ preventive chemotherapy and the health system have been made with support of several institutions, organisations and partners who have provided technical and financial support. They include USAID/NTDCP, CNTD, WHO, Ghana, AFRO, HQ, APOC, MDSC, Sightsavers and Government of Ghana working through the Ghana Health Service at the National, Regional, District and Sub-district health management teams. The role of the endemic communities cannot be over-emphasised.

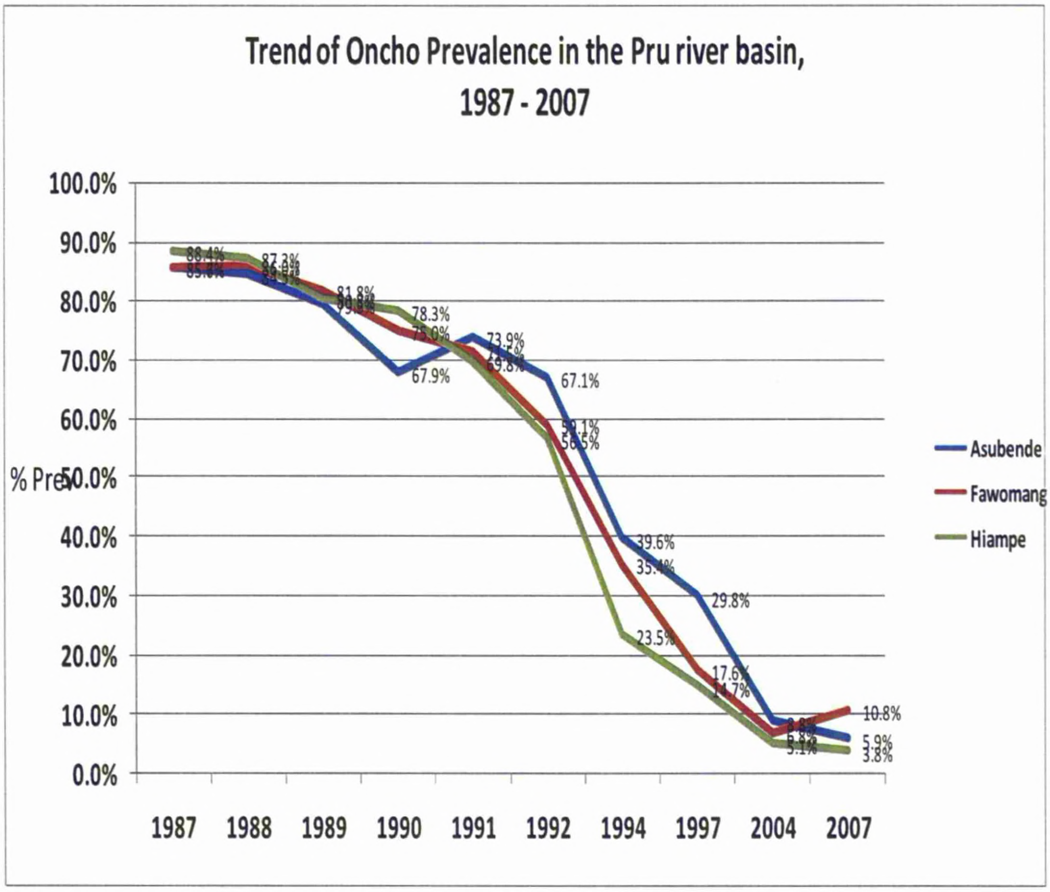
Ghana is endemic for all the preventive chemotherapy diseases among the NTDs (Table 10.1). The LF elimination programme became the platform for the inception of some programmes, reviving of others and implementing the integrated NTDs Programme, which included implementing control activities for schistosomiasis, and the soil transmitted helminthiasis. Of the 170 districts in Ghana 74 are endemic for LF, 40 are hyper or meso endemic for onchocerciasis, 29 are endemic for trachoma, 141 have established endemicity for schistosomiasis though all 170 districts are endemic for soil transmitted helminthiasis prevalence is generally low (Table 10.1).

10.4 Impact on Onchocerciasis Control

The main goal of onchocerciasis programme is to reduce its transmission to levels at which they will no longer be of public health significance and preventing recrudescence of the disease. This involves ensuring a target therapeutic coverage of 85% and a geographic coverage of 100%, and maintaining black fly infectivity of less than 0.5/1000 parous flies and community microfilarial load of less than 0.5 per skin snip. The Ghana Oncho programme is part of the NTD control programme that ensures co-implementation of other products especially at co-endemic areas. Through the NTD programme there has been selection of priority areas for ivermectin distribution for onchocerciasis, mapping of breeding sites within the Black Volta Basin, several CDTI training workshops asides the annual refresher training programmes for distribution. Several entomological and epidemiological surveys for onchocerciasis have also been undertaken which results have shown marked improvement in the onchocerciasis situation in the country. Remapping of onchocerciasis has been undertaken and twice annual treatment of onchocerciasis using ivermectin is provided under the programme for onchocerciasis hyper- and meso endemic areas.

During this period trends in the transmission of onchocerciasis within many of the onchocerciasis endemic river basins have declined particularly in communities within Pru and Bui river basins, both in the Brong Ahafo region as part of the Special Intervention Zones (SIZ) of the Onchocerciasis Control Programme in Ghana. These were onchocerciasis hotspots, which were identified at the closure of the former Onchocerciasis Control Programme (OCP) in 2002 with devolution of the programme to the countries.

Figure 10.2: NTDs Programme Data from Impact Surveys Conducted showing Reducing Trends in Onchocerciasis Prevalence in the Pru River Basin



The communities surveyed within the Pru River basin were Asubende, Fawomang and Hiampe where onchocerciasis prevalence obtained by skin snipping has reduced from 85.7%, 88.4% and 85.6% in 1987 to 6.8%, 8.8% and 5.1% in 2004 but increased to 5.9%, 10.8% and 3.8% respectively, while those surveyed in the Black Volta Basin were Baffour Akura and Bui Damn site showed declining trends from 52.9% and 38.2% in 1987 to 14.3% and 13.6% in 2001 and showed rising trends to 33.8% and 18.8%. However from 2004 to prevalence from 8.8% in Asubende to 5.9% since the programme was merged with the LF programme (Figures 10.2 and 10.4).

Figure 10.3: NTD Programme Data from Impact Surveys Conducted showing Trends of Onchocerciasis Prevalence in the Bui Black Volta Basin from 1987-2007

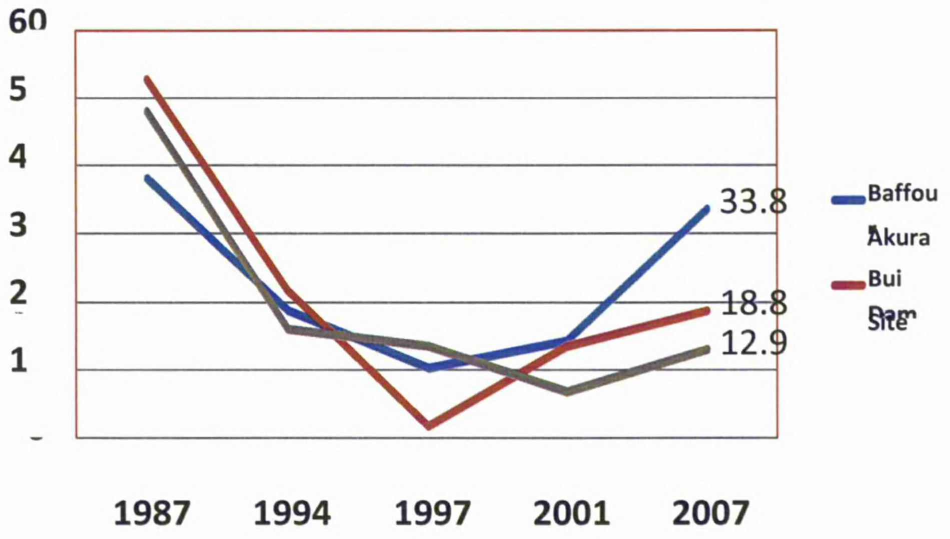
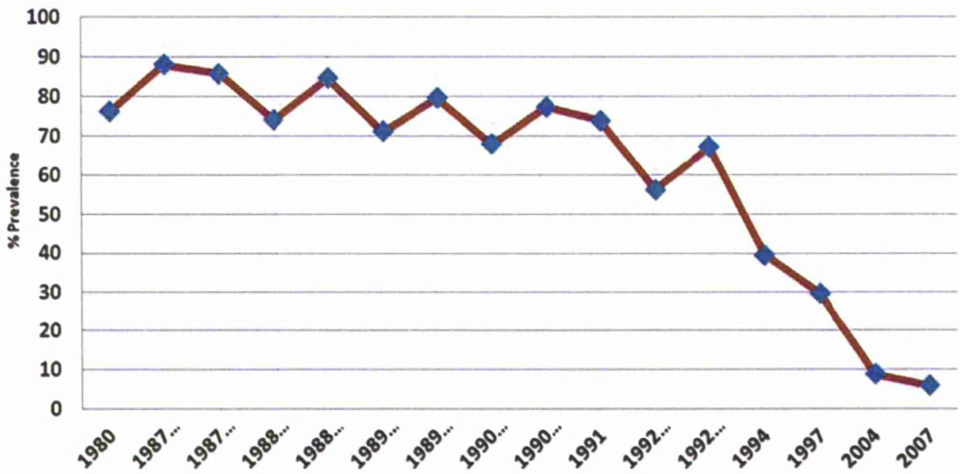


Figure 10.4: NTD Programme Data from Impact Surveys Conducted showing the Reducing Trend of Onchocerciasis Prevalence at Asubende in the Pru River basin between 1980 and 2007 in Ghana



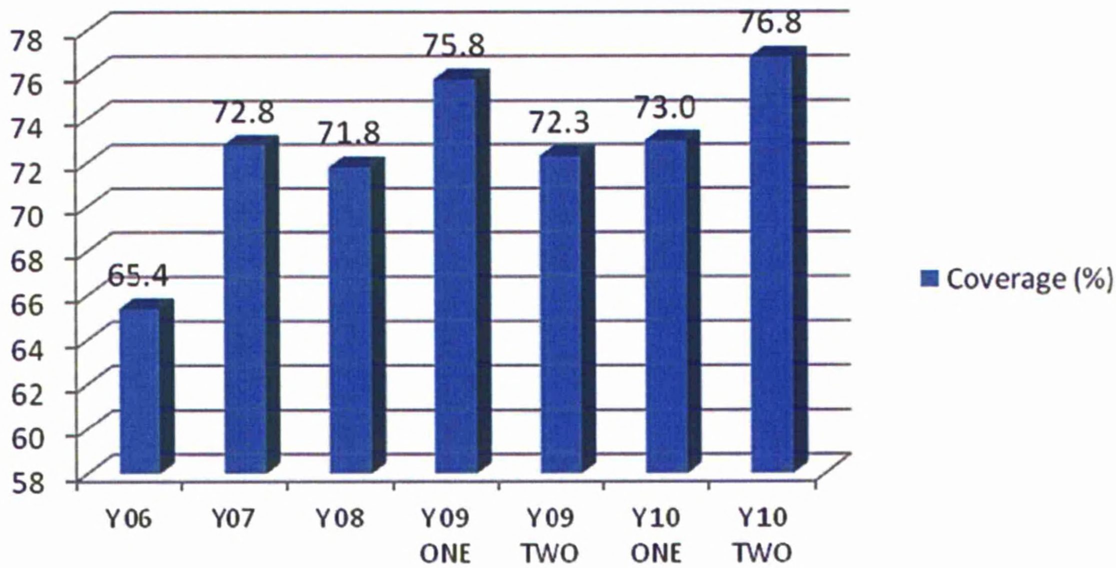
The LF filariasis programme has also provided the platform for mapping of schistosomiasis and re-mapping of onchocerciasis in Ghana. These were carried out in 2008 and 2009 respectively with maps that have since been employed to guide MDA and impact monitoring of the two programmes.

10.5 Remapping of Onchocerciasis

Through the NTD programme there has been selection of priority areas for ivermectin distribution for onchocerciasis, mapping of breeding sites within the Black Volta Basin, several CDTI training workshops asides the annual refresher training programmes for distribution. Several entomological and epidemiological surveys for onchocerciasis have also been undertaken which results have shown marked improvement in the onchocerciasis situation in the country. Remapping of onchocerciasis has been undertaken and twice annual treatment of onchocerciasis using ivermectin is provided under the programme for onchocerciasis hyper- and meso endemic areas. Remapping of onchocerciasis results was combined with recent epidemiological and entomological survey results to establish the areas of hyper- and meso-endemicity for onchocerciasis treatment in the country (Figures 10.5 and 10.6). Nine of the ten regions in Ghana are endemic for onchocerciasis. About 3115 communities from 40 districts have been identified for treatment under the onchocerciasis programme. The total population found in these communities is therefore 2,075,542, which is being offered biannual treatment with ivermectin. With the shift in onchocerciasis strategy from control to elimination, all communities historically known to be onchocerciasis endemic have been identified and are also under annual treatment with ivermectin.

Since the merging of the onchocerciasis programme with the LF programme treatment for onchocerciasis has been regular with major consistent improvements in both annual and biannual geographic and total population/therapeutic coverage. Coverage has improved from 65.4% in 2006 to 76.8% in 2010. Geographic coverage has also improved from 82.8% in 2007 to 100% in the first round in 2009. The treatment 2010 recorded a geographic coverage of 97.7% (Figures 10-7 and 10-8) .

Figure 10.7: Treatment Coverage from 2006-2010 since the Merging of Onchocerciasis Control and LF Elimination Programmes



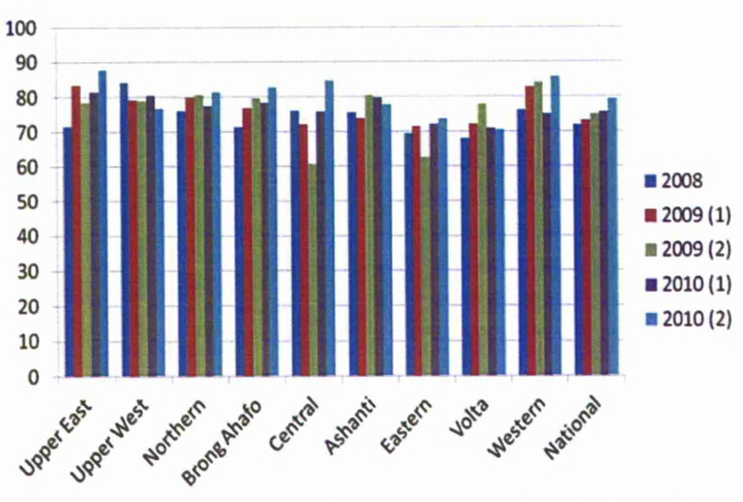


Figure 10.8: Regional Trends of Ivermectin Treatment Coverage in Ghana from 2008-2010

10.6 Impact on Soil Transmitted Helinthiasis and Schistosomiasis

The LF Elimination Programme has also provided a major platform for the control of schistosomiasis and soil transmitted helminths control with marked health process impacts. Prior to the inception of the integrated NTD control activities and through the LF programme an estimated number of about 13,161,673 (Table 10.5) school-aged children had been de-wormed with albendazole through the community-based treatment for LF using ivermectin and albendazole over 10 annual rounds of MDAs. From 2007 to 2010, other de-worming activities have been carried out in collaboration with the School Health Education Programme of the Ghana Education Service. In 2007, 4,326,621 school-aged children were de-wormed; in 2009, 802,561 school-aged children were de-wormed, and, 1,739,857 children in 2010 whilst 1,355,189 children were de-wormed through the collaboration with GES/SHEP programme. A total of 21,385,801 treatments have been achieved through the school-aged de-worming programme, which has been mainly school-based.

Table 10.4: Treatments Achieved with Mass Drug Administration for Soil Transmitted Helminthiasis and Schistosomiasis under LF Elimination and the Integrated NTD Programme

	Treatments	
Activity	**STH**	**SCH**
Under LF Programme (2001-2010)	13,161,573	-
2007	4,326,621	-
2009	802,561	802,561
2010	1,739,857	1,739,857
2011	1,355,189	1,517,963
Total Treatments	21,385,801	4,060,381

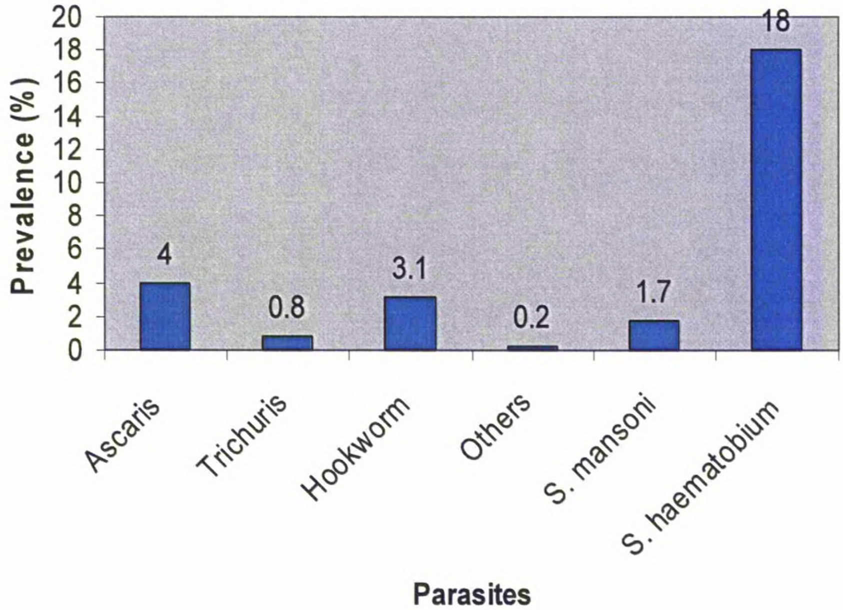
Since 2009 mass treatment for schistosomiasis using praziquantel has also been carried out regularly also in collaboration with the Ghana Education Service (GES)/ School Health Education Programme (SHEP) programme. In 2009, 802,561 school-aged children were treated for schistosomiasis, in 2010, 1,739,857 children were again treated, and 1,355,189 school-aged children were also treated in 2011. Through the community-based approach high at-risk communities identified through the mapping and validation were also identified for treatment resulting in the treatment of 162,774 community members with praziquantel. In all 4,060,381 treatments (Table 10.5) have been conducted with praziquantel for schistosomiasis control.

Table 10.5: School-Aged Children (SAC) De-wormed under the LF Elimination Programme

Year	Districts Treated for Lymphatic Filariasis (N)	At-Risk Pop (N)	Ivermectin used (N)	Albendazole used (N)	Total Number of People Treated (N)	Total Number of Dewormed Sch-Aged Children (N)	MDA Coverage (%)
2001	5	333,686	1,001,000	333,596	246,743	67,361	73.9
2002	14	1,643,211	5,743,056	1,914,400	1,217,936	332,497	74.1
2003	30	3,696,893	9,100,000	3,522,000	2,622,722	716,003	70.9
2004	40	5,378,143	13,967,000	5,180,000	3,971,869	1,084,320	73.9
2005	60	6,907,375	25,000,000	8,598,900	5,141,482	1,403,625	74.4
2006	61	8,851,923	25,234,485	8,060,000	6,359,200	1,736,062	71.8
2007	61	9,278,935	24,080,000		5,932,174	1,619,484	63.9
2008	74	10,334,602	26,856,250	9,407,600	7,313,521	1,996,591	70.8
2009	74	10,331,867	25,575,000	8,035,100	7,913,735	2,160,450	77.3
2010	74	9963010	28,663,500	8,503,400	7491873	2,045,281	75.2
			185,220,291	53,993,541	40,687,937	13,161,673	

Identification of schistosomiasis endemic districts and communities for treatment have been based on initial baseline data collected in 2006, mapping data collected in 2008 and then data collected to validate the mapping and also improve on the mapping results.

Figure 10.9: Aggregated Prevalence of Infection from Baseline Schistosomiasis Surveys



10.7 Impact on Trachoma Elimination

Trachoma mapping established its endemicity in 29 districts in 2 regions in Northern Ghana namely Upper West and Northern regions. Surgery for trachoma trichiasis, mass treatment with the antibiotic, azithromycin, has been undertaken annually, facial cleanliness with regularly washing with soap and clean water, and environmental improvement has been implemented as the SAFE strategy for trachoma elimination. The results have been near elimination of trachoma transmission from Ghana. There is also a backlog of trachoma trichiasis that requires surgery. All these achievements were realised through the integrated NTD programme. The programme has established an integrated community-based surveillance system and will require a re-evaluation of transmission after a three-year period of post-elimination surveillance before possible certification of transmission elimination.

10.8 Impact on the Health System

The LF elimination programme through its contribution to improvements in the health system can be demonstrated at several levels of the system. These are illustrated at the national, regional, district/sub-district and community levels through its contribution to the health system's policies, strategies and plans of work, resources and activities.

At the national level, the programme at its initiation made available equipment in the form of computers, vehicles and furniture by its partners to complement government's efforts in making available human resource personnel in the form of the programme manager, a deputy and technical officers to coordinate and administer the Ghana Filariasis Elimination Programme (GFEP). Government also provided office space at the national level. Through the programme and in an effort to ensure integration of the programme in the health system, each endemic region also appointed programme coordinators who helped to ensure the smooth running of the programme within all endemic regions. These LF regional programme coordinators also assumed the role of coordinating other preventive chemotherapy NTDs within the health system in addition to providing other services to the public health system. Training has been provided at regional, district and sub-district levels by the LF and then the NTD programme to ensure the availability of capacity within the health system to carry out the activities of the programme and other health systems activities in as integrated a manner as possible.

Endemic communities have been empowered through the provision of health education community-directed treatment approach to ensure distribution of the drugs with improvements in the health status. These are provided through training of the community distributors, meetings with community leaders and whole communities where they are given the opportunity to ask questions. This health education approach provided enabled communities to monitor the drug distributors and distributions process themselves. Apart from the benefit of providing communities with protection against LF various ancillary benefits of ivermectin and albendazole have been reported. This includes treatment for intestinal worms, head lice and improvements in sexual libido.

The LF Elimination Programme through its strategic documents has contributed to the health policy and strategies at the national level. These include inputs in terms of both human contribution and materials into the Ghana Poverty Reduction Strategies II, the MDG 6, and New Partnership for African Development Health Strategy, the African Union Health Strategy and the Ghana Health Sector Strategic Plan and the Integrated Disease Surveillance and Response (IDSR).

International and local partnerships have also been employed by the programme to strengthen the health system through both technical contributions and resource allocation through the programme. The programme has also improved on its local partnership with organisations like GES (Ghana Education Service), central and local government, Food and Drugs Board who help to monitor the quality of drugs distributed and severe adverse reactions during MDAs, drug companies, multilaterals and bilateral organisations, international support institutions/centres, NGOs and endemic communities).

10.9 Challenges of Elimination of Lymphatic Filariasis

Major challenges encountered with the implementation of LF elimination activities have been in the area of monitoring and evaluation. Others include weak data management at all levels, ensuring a feedback for all programme activities, synchronizing funding from different partners under the NTD Control Programme, implementation of community-directed treatment in the context of NTD control programme and human resource constraints. Inadequate financial support for surveillance activities is one notable challenge, which has led to continuation of MDA inspite of many rounds of distribution activities. The evidence required to justify ending of the annual distribution process has not been available.

Other challenges have been timing of treatment cycle in the light of implementation of bi-annual treatment, competing competing health programmes at regional and district levels, apathy among regional and district staff, advocacy for political commitment at the highest level, cross-border issues (coordination of treatment and other cross-border activities such as supervision of MDA).

10.10 Major Recommendations

Collaboration with partners to build capacities of regional and district staff for effective management of LF and other NTD surveillance activities and further collaboration with other agencies to deal with challenging epidemiological situations that arise on the programme is absolutely essential.

The need to acquire equipment for surveillance activities, provide training for more technicians for surveillance activities for most of the regions to lessen the work load and improve quality and volume of work and ensure that strategic plans to address all programme issues are available.

To improve on the impacts made so far the programme needs to strengthen advocacy with stakeholders and improve in-country fund-raising. Advocacy for inclusion of MDA coverage indicators into the Ghana Health Service set of indicators will improve on the attention given to the programme by the regional and district health officers and greatly reduce apathy to the programme.

10.11 Conclusions

Elimination of LF with mass chemotherapy is possible and has been demonstrated by the Ghana Filariasis Elimination Programme in 4 districts. The total population coverage of 80% required to ensure elimination of the disease within the timeframe of six years eluded the programme. Surveyed coverage has mainly been consistent with the reported coverage on the programme for most of the programme areas.

The five start up districts, most of which had high prevalence of LF have shown that in such a situation more annual rounds of mass treatment are required to ensure elimination. In the meantime there is the need to consider the application of other strategies such as mosquito vector control to speed up the process of elimination.

Integration with other NTDs has been effective and cost-efficient with added improvements on the general health system including the endemic communities.

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Appendices

Appendix I: Combined Knowledge, Attidute and Practices, Coverage and Non-Compliance Assessment Questionnaire

Name of Interviewer.. Date of Interview...

Community .... Sub-district...

District...

My name is .... I am working for the Ghana Health Service and want to have a discussion with you about the drugs that were distributed this year and for which the height of people were measured before the drugs were given. The purpose of this exercise is to help improve on future drug distribution programmes and also find out ways of helping people with elephantiasis or hydrocoele disease.

Interviewer

Please note that multiple correct answers are allowed where applicable. The codes for Yes is 1, No is 2, other, specify is 7, don't know is 8 and not applicable (N/A) is 9.

Section A: Socio-demographic Data

1. Name of respondent

....

2. Age [ ] [ ]

3. Sex 1. Male 2. Female

4. Marital Status 1. Married 2. Single 3. Divorced 4. Widowed

5. Number of people in this household [ ] [ ]

6. Occupation 1. Farmer 2. Fisherman 3. Teacher 4. Artisan
5. Trader 6.Other, specify.............................

7. Religion: 1. Christian 2. Moslem 3. Traditional Relig 4. None
5 Other, specify...............................
8. Number of completed years of education [ ] [ ]

Section B: Knowledge about the Disease

9. Have you heard about the disease filariasis? 1. Yes 2. No

10. If yes, how does it present in an affected individual? (Multiple correct answers are allowed)
1. Enlarged Legs 2. Enlarged Scrotum 3. Enlarged Arms
4. Enlarged Breasts 5. Fever and Chills 6. Painful swollen groin
7. Other, specify..

11. How is this disease acquired?
1. Through the bite of a mosquito 2. Breathing in the germs
3. Eating contaminated food 4. Drinking contaminated water
5. Other, Specify..

12. Which germs are responsible for the disease?

1. Tiny worms in the body 2. Bacteria 3. Viruses
7. Other, Specify........................... 8. Don't Know

Section C: Management and Programme

13. How is lymphatic filariasis disease prevented? (Multiple correct answers are allowed)

1. By taking drugs 2. Sleeping in Insecticide treated mosquito nets
3. Keeping a clean environment 7. Other, specify............................
8. Don't know

14. Are you aware of any drug distribution in this community this year for which people were measured?

1. Yes 2. No

15. How many different drugs are given during the exercise? [ ] [ ]

16. What categories of people should not take the drugs?

1. Children less than a certain height 2. Pregnant women
3. Breastfeeding mothers 4. Seriously sick people
7. Others, specify....................................

17. Did everybody in your household take the drugs?

1. Yes 2. No 8. Don't Know

18. What reasons do people give for refusing to take the drugs?

....

....

....

19. Are you aware of any side effects of taking these drugs?

1. Yes 2. No

20. What are some of the side effects of taking these drugs?

(Multiple correct answers are allowed)

1. Itching 2. Rashes 3. Swelling of parts of the body 4. Headache

5. Fever 6. Chills 7. Other,

Specify...

21. If the drugs were given again, would you want it to be distributed the same way?

1. Yes 2. No 3. Don't Know 8. N/A

22. How many time have these drugs been distributed in this community?

[ ] [ ]

23. How many times have you taken these drugs yourself?

[ ] [ ]

24. What suggestions do you have for improving mass drug distribution exercises?

....

.

....
.

....
.

25. Do you know anynone with elephantiasis or a hydrocoele?

1. Yes 2. No

26. Is there anyone in this household with any of the two conditions?

1. Yes 2. No

27. Is any treatment available to people with these conditions in this community?

1. Yes 2. No 8. Don't know

28. What help is available for people with hydrocoeles?

....
.

....
.....

29. What help is available for people with elephantiasis?

....
.

....

.

Thank you for spending time to answer these questions for me, if you have any questions and difficulties concerning this exercise of the Filariasis Elimination Programme after we have left you contact personnel of the health centre for help or the research student in the person of;

Dr Nana Kwadwo Biritwum
Health Research Unit
Ghana Health Service
P.O. Box GP-184
Accra
Ghana

HOUSEHOLD NON-COMPLIANCE INTERVIEW

INTERVIEWER: ASK TO TALK WITH ALL THOSE WHO ARE PRESENT IN THE HOUSEHOLD AT THE TIME OF INTERVIEW (Head of household will answer for those not present)

Name (Number Names)	Sex	Age	Currently Present Yes/No	Disease Status Yes / No / NA		Indicate Yes or No for Taking of Drugs and Put the code for side reactions experienced or reason for not taking the drugs in brackets for any particular years' treatment in the box.					
				El	Hy	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6

El – Elephantiasis Hy-Hydrocoele

If answer for drug received is No put in one of the following codes

1. Less than 90cm 2. Pregnant 3. Severely ill 4. Absent during treatment 5. Breast feeding 6. Other specify......................

*Did anybody have any problem within two days after taking the drug?

1. No problem 2. Fever 3. Headache 4. Vomiting 5. General Muscle Pains 6. Dizziness 7. Itching 8. Diarrhoea 9. Other, specify.................... 10. NA

Appendix II : Morbidity Control Programme Assessment Questionnaire

Name of Interviewer................................ Date of Interview.....................

Community... Sub-district..........................

District...

My name is .... I am doing this work for the Ghana Health Service and want to have a discussion with you about the programme that is aimed at preventing and also providing help for people with lymphatic filariasis disease. The purpose of this exercise is to enable us determine if the programme is reaching out to the people with this disease and if those receiving this help are happy with the programme.

Interviewer
Please note that multiple correct answers are allowed where applicable. The codes for Yes is 1, No is 2, other, specify is 7, don't know is 8 and not applicable (NA) is 9

Section A: Socio-Demographic Data

1. Name of respondent
....

2. Age [ ] [ ]

3. Sex 1. Male 2. Female

4. Marital Status 1. Married 2. Single 3. Divorced 4. Widowed

5. Number of people in this household [ ] [ ]

6. Occupation 1. Farmer 2. Fisherman 3. Teacher 4. Artisan 5. Trader 7.Other, specify.............................

7. Religion 1. Christian 2. Moslem 3. Traditional Religion 4. None 7. Other, specify................................

8. Number of completed years of education [ ] [ ]

Section B: Knowledge and Participation

9. Have you heard about the disease filariasis? 1. Yes 2. No

10. If yes, how does it present in an affected individual? (Multiple answers are allowed)

1. Enlarged Legs 2. Enlarged Scrotum 3. Enlarged Arms
4. Enlarged Breasts 5. Fever and Chills 6. Painful and swollen groin
7. Other, Specify........................

11. How is this disease acquired?

1. Through the bite of a mosquito 2. Breathing in the germs 3. Eating contaminated food 4. Drinking contaminated water

7. Other, Specify..

12. Which germs are responsible for the disease?

1. Tiny worms in the body 2. Bacteria 3. Viruses

7. Other, Specify................. 8. Don't know

13. How is lymphatic filariasis disease prevented?

(Multiple answers are allowed)

1.By taking drugs 2. Sleeping in Insecticide treated mosquito nets

3. Keeping a clean environment 7. Other, Specify.......................................

14. Are you aware of any drug distribution exercise in this community for which the heights of people were measured?

1. Yes 2. No

15. How many different drugs are given during the exercise? [ ] [ ]

16. Did you take and swallow some of the drugs during the distribution?

1. Yes 2. No

Interviewer:

For patients with elephantiasis complete section C;

For patients with hydrocoeles complete section D;

If patient has both conditions complete sections C and D;

Section C: Elephantiasis Patient

17. For how long have you had elephantiasis? [ ] [ ]

18. Are you aware of the availability of help for patients with elephantiasis?

1.Yes 2. No

19. What treatment is available for people with elephantiasis?

1. Medication 2. Surgery 3. Medication and Surgery

7. Other, specify............... 8. Don't know

20. Have you been given a copy of the small book, which teaches you how to care for your elephantiasis leg?

1. Yes 2. No

21. Have you been taught how to apply the instructions in this booklet?

1. Yes 2. No 9.N/A

22. How do you take care of your leg?

(Multiple correct answers are allowed)

1. Regular washing 2. Exercising 3. Limb elevation 4. Proper wound care

7. Others, Specify.............................

23. What do you do when you get an acute attack?

(Multiple correct answers are allowed)

1. Immerse leg in cold water 2. Take painkillers 3. Go to the hospital

4. Go to the traditional healer 7. Other, specify ....

8. Don't know

24. For how many years have you been undertaking limb washing?

[ ] [ ]

25. Have you seen any improvement in your condition since you started limb washing?

1. Yes 2. No 9. N/A

26. How many times did you have acute attacks each year before starting this treatment?

[ ] [ ]

27. Have you noticed a change in the number of acute attacks you get each year since you started the limb washing?

1. No change 2. Yes, it is increasing 3. Yes, it is reducing 9. N/A

28. How many times have you had an acute attack this year? [ ] [ ]

Have you noticed a change in the size of your limb since you started the limb washing?

1. No change 2. Yes, it is getting bigger 3. Yes, it is getting smaller 9. N/A

Section D: Hydrocoele Patient

30. For how many years have you had a hydrocoele? [ ] [ ]

31. Are you aware of the availability of treatment for people with hydrocoeles?

1. Yes 2. No

32. Have you made any attempt to seek treatment for your condition?

1. Yes 2. No If No, why?..

33. What kind of treatment is available for people with hydrocoeles?

1. Medication2. Surgery 3. Medication and Surgery?

7. Other, specify................ 8. Don't know

34. Have you had any treatment for your hydrocoele?

1. Yes 2. No

If No,

why?...

.....

35. If yes, what was the outcome of this treatment?

1. Good 2. Bad 7. Other, specify...............................

9. N/A

36. Is this treatment free?

1. Yes 2. No 9. N/A

If No, how much did you pay?

....

37. Are you happy with the results of this surgery?

1. Yes 2. No 3. Cannot tell 9. N/A

Appendix III : End Point Determination

Protocol for Bm14 IgG4 Antibody Assay

Sensitize a 96 well plate with 100ul Bm14-HIS per well (2ug Bm14-HIS per ml in carbonate buffer, pH 9.6) overnight 37°C. Sensitize another plate with 2 ug/ml control Cat-HIS antigen in carbonate buffer.

Next morning shake out the antigen solution, wash 3 times with PBS/Tween, and block by adding 200 ul per well PBS/T/FCS (PBS/Tween with 5% v/v fetal calf serum) 30 minutes at 37°C.

Wash plate 3 times with PBS/Tween.

Dilute sera 1:100 in PBS/T/FCS (5 ul serum plus 495 ul diluent).

For serum sets expected to have many positives:
Test sera in duplicate wells on each of the plates (100ul of 1:100 dilution per well), incubate 2 hours 37°C. Include controls; 2 wells each of a positive filarial antibody serum pool and a nonendemic normal human serum pool. Each lab must produce and test its own positive and negative control samples. We dilute our positive pool so that it produces a net O.D. between 2.0 and 3.0 (i.e., not "over" or starring out the reader).

For serum sets expected to have few positives:
Test one well per serum. Retest positives in another run with duplicate wells for conformation.

Wash plates 3 times with PBS/Tween.

Conjugate:
Add 100ul peroxidase labeled anti-human IgG4. Working dilution must be worked out by your lab.

Wash plate 3 times with PBS/Tween.

Substrate:
Add 100 ul OPD substrate solution per well, and incubate in the dark, 10min, room temperature. (Other substrates such as premixed ABTS or TMB can be used, but we have not used these extensively).

Stop the OPD substrate reaction by adding 50ul of 4 M sulfuric acid to each well. (Be careful with acid! Add acid to water for dilution).

Scoring results:

Read OD 490 and calculate mean OD values for each serum tested. (When duplicate values do not agree regarding positivity, the serum should be retested). (Note that it is desirable to use 490 with a second reference wavelength over 600 nm if possible to correct for imperfections in ELISA plates). (We keep aside wells G11 and G12 as blanks and blank the reader with water in those wells). Subtract mean OD values on the Cat-HIS plate from those on the Bm14-HIS plate to get the mean net OD. The cutoff net OD value is the mean plus 3 SD of the net OD values obtained with the panel of negative sera. Cutoff values will vary from lab to lab, but they should be in the range of 0.100 to 0.200. Note that most sera will give very low OD values with the Cat-HIS control antigen. However, we like to test the sera in parallel to catch the unusual serum that reacts with Cat-HIS in the IgG4 assay. You may find that this is not necessary. Your positive control pool is your proof that the assay is working properly.

Note: Before you start testing your sera:

It is necessary to start with a technical run with 10 to 20 of your own non-endemic (not exposed to filariasis) sera and a few of your own positive sera to make sure the reagents are working and to define the background cutoff for the assay in your laboratory. We use the mean plus 3 SD of the net OD obtained with the panel of negative sera to define the cutoff for a positive test. This tends to be approx 0.150 in our lab conditions. Control serum samples generally look water clear in the ELISA and wells in the CAT-his control antigen plate are also usually water clear. If a serum produces an O.D. value with the control antigen that is as high or higher than that produced on the Bm14 plate, the result is indeterminate/invalid.

Buffer Recipes

Carbonate buffer (0.06M, pH 9.6)(for sensitizing plates with antigen):

Buffer A: 1.0M Sodium Bicarbonate ($NaHCO_3$) 8.4g in 100 ml dH_2O.

Buffer B: 1.0M Sodium Carbonate (Na_2CO_3) 10.6g in 100 ml dH_2O.

Combine 22.65 ml Buffer A, with 9.1 ml Buffer B, and dilute to 500 ml with dH_2O.

PBS Stock Solution to make PBS/Tween Wash

54.8g Sodium Phosphate Dibasic (Na_2HPO_4) into 772 ml dH_2O.

15.75g Sodium Phosphate Monobasic (NaH_2PO_4) into 228 ml dH_2O.

Dilute to 2000ml with d dH_2O

PBS/Tween Wash (Tween concentration is 0.05%)

240ml PBS Stock Solution

51g Sodium Chloride NaCl

3.0 ml Tween 20 (Sigma)

Dilute to 6000 ml with dH_2O.

PBS/T/FCS (Blocking solution and diluent for sera)

PBS/Tween with 5% fetal calf serum (heat inactivated serum, 56 C for ½ hr)

Citrate Buffer (for OPD substrate):

Buffer A. 9.6g Citric Acid, 500ml dH_2O.

Buffer B. 26.87g Dibasic Sodium Phosphate (Na_2HPO_4) in 500 ml dH_2O.

Add 486 ml of A. to 500 ml B. Adjust pH to 5.0

OPD substrate solution:

4mg OPD (O-phenylenediamine, Sigma Chem. Co., St. Louis, MO, USA) in 10ml Citrate buffer, 2 ul of 30% H_2O_2. OPD is poorly soluble and must be added at least 20 minutes before you plan to use the substrate. Add H_2O_2 at the last minute. (Substrate must be made up daily. Keep substrate in the dark until you use it. Plates with substrate must be incubated in the dark).

ELISA PLATES:

We have found that polyvinyl plates work best in this assay. These can be flat or round bottomed (for example, Vinyl U bottom plates, Part No. 2401,ThermoLab Systems, 8 East Forge Parkway, Franklin, MA 02038. Tel 800 522 7763). Immunlon 4 plates do not work well.

Appendix IV : Methods for calculating indirect costs

Average daily wage used for the calculation of the indirect cost of surgery to both patient and caregiver was ¢16,500.00 (Minimum daily wage in Ghana – as at 24/10/06)

In calculating the hourly wage, 8 working hours per day was used.

Exchange rate of the Ghanaian Cedi to the US Dollar (April 2006) - $1.00: ¢9,000.00

Appendix V: Verbal Consent Form

Knowledge, Attitude and Practice, Coverage and Non-Compliance Study Consent Form

My name is .... I am doing this work for the Ghana Health Service in order to help assess the effect of the drug distribution programme and also improve on the health services provided to the people of Ghana.

This discussion is about the two drugs that are distributed every year and for which the height of people are measured before the drugs are given.

You have been selected randomly and hope you will take a moment and volunteer answers to all the questions. We cannot give anything for answering the questions but please note that your answers will be important in helping improve the health status of the people in this community.

We will record your name but this will only help us to trace you if there is any problem, however your name will not be linked to any answers that you provide and will not be shared with anybody. No one will know that the answers are yours.

You may refuse to answer the questions and will not be penalised if you refuse to answer the questions. If you are uncomfortable with any question you may also decline to answer them or withdraw at any point in the interview.

The questions are about the drug distribution exercise and the participation of yourself and your household in the exercise.

The report from this study will be shared with your community after this work is complete without making any reference to any individual response.

Will you like to participate in the survey? Yes..........
No.................

If no thank the person and move on.

If you have any queries or difficulties after I have left you may contact the head of the local health centre for any clarification with regards to this study or contact the following person;

Dr. Nana Kwadwo Biritwum
Health Research Unit
Ghana Health Service
P. O. Box GP-184
Accra - Ghana

Signature/Thumbprint...

Date....................................

Appendix VI: Blood Survey Consent Form

This blood sampling exercise will help us determine the disease levels of lymphatic filariasis in this community after so many years of taking the drugs in this community annually.

We are selecting 500 people as they willingly come, take a tiny sample (about 100 microlitres) of blood from your finger tip for later analysis. It will involve pricking the finger which may be a bit painful but do not worry as the pain associated will disappear soon afterwards. In order to prevent infection the site will be cleaned very well before and after the prick. We do not expect any bleeding after taking the blood sample.

Blood taken will be put on a slide and studied in the laboratory for the disease. People found to have the disease but missed the treatment will be followed up and offered the treatment.

We will also ask you a few questions about yourself and participation in this survey. You may or may not answer the questions or decline to allow your blood to be taken at any point. You will not be penalised in any way for withdrawing your participation.

Your blood test results will not be shared with anyone but kept strictly confidential. You will only be contacted if there is the need to give you some treatment. The results of the whole exercise will be shared with the community without making reference to individual results.

The consent of community leaders and then the parents of children less than 5 years of age will both be sought before collecting finger prick blood for the antigen or antibody analysis.

In case of any further queries or difficulties after we leave, you may contact the one in-charge of your local health centre for help.

Will you like to participate in the survey? Yes..........
No.................

If no thank the person and move on.

Would you allow your child's finger prick blood sample to be taken?
Yes...................................... No................................

If you have any problem you may contact the following person;

Dr. Nana Kwadwo Biritwum
Health Research Unit
P. O. Box GP-184
Accra – Ghana

Signature/Thumbprint...
Date............................

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

My Ref. :GHS-ERC: 3
Your Ref. No.

Your Health - Our Concern

Health Research Unit
Ghana Health Service
P. O. Box GP-184
Accra

14th November 2006

Tel: +233-21-681109
Fax + 233-21-226739
Email: Hannah.Frimpong@hru-gh

ETHICAL CLEARANCE
ID NO: GHS-ERC – 10/9/06

The Ghana Health Service Ethics Review Committee, after receiving response to issues raised on your protocol submitted for expedited review, has given approval for commencement and implementation of your Project titled:

"The Epidemiology and Control of Lymphatic Filariasis in Ghana"

PRINCIPAL INVESTIGATOR – Dr. Nana Kwadwo Biritwum

This approval requires that you submit periodic review of the protocol to the Committee and a final full review to the Ethical Review Committee (ERC) at the completion of the study. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification of the project must be submitted to the ERC for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to inform the ERC and your mother organization before any publication of the research findings.

Please always quote the protocol identification number in all future correspondence in relation to this protocol

SIGNED...
MR. ANNOR NIMAKO
(GHS-ERC VICE CHAIRMAN)

Cc: The Director
Health Research Unit
Ghana Health Service
Accra

Appendix VII: Ghana Health Service Ethical Approval Letter